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CONTENTS.

EDITORIAL: PAGE.
Paragraphs ... 257

ILLUSTRATED ARTICLES:
ELECTRICAL WORLD Portraits.—No. XXXIII ... 258
The Kinematics of the Rotary Field, by John F. Kelly ... 259
The Deprez and Carpentier Patent, by R. M. Hunter, M. E ... 260
A Thermal Method of Measuring Periodic Currents, by Albert L. Clough ... 260
Application of the Weston Voltmeters and Ammeters to Practical Electrical Measurements: IV.—by H. Maschke, Ph.D ... 260
A Practical Electric Meter ... 262
A New Electric Traveling Crane ... 262
Decorative Electric Lighting ... 262
The Practical Operation of the Gearless Motor, by S. H. Short ... 263
A New Automatic Engine ... 267
Combination Pliers ... 267
Pendant Switches and Cut-Outs ... 268
A New Oil Pump ... 268
New Edison Rheostat ... 268

MISCELLANEOUS:
Power Transmission at Niagara, by F. E. Pritchard ... 258
Annual Report of the Thomson-Houston Electric Company ... 265
Modern Views Respecting the Action of Forces and the Conception of the Ether, by Wm. Stanley, Jr ... 265
The World's Electrical Congress ... 266
New Books ... 268

FINANCIAL INTELLIGENCE: The Electrical Stock Market, 269; New Incorporations, 269; Affairs of the Companies, 269.

SPECIAL CORRESPONDENCE: New York Notes, 269; New England Notes, 270; Western Notes, 270; Inquiries from Correspondents, 270; Answers to Correspondents, 270.

NEWS OF THE WEEK: The Telegraph, 270; The Telephone, 271; The Electric Light, 271; The Electric Railway, 271; Legal Note, 271; Personal, 271.

INDUSTRIAL AND TRADE NOTES ... 271

BUSINESS NOTICES ... 272

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 272

Thomson's Meter Prize Money. IT will be remembered that the municipality of Paris some time ago offered a prize for the best electric meter, and that the meter of Prof. Elihu Thomson with that of Aron received the first prize, amounting to 10,000 francs, or about $2,000. Prof. Thomson has just presented the money won by his meter to the Académie des Sciences, of Paris.

A Messenger Boy Who Hurried. BROOKLYN reports that a messenger boy in that city on one occasion hurried in delivering a telegram, and as he was not accustomed to it he collided with one of the lamp posts, which ordinarily are such a support for these boys. The result was that the boy was hurt and that the message was delayed in its delivery. He instituted a claim for $10,000 damages against the company. His claim is that it was a hazardous occupation to hurry, but the company will probably win the suit on the plea that he disobeyed orders. The public will not be affected by this because our local telegraph system is so wretched that it is of little use to anybody.

Some Important Electrical Notions. DURING the electrical exposition in Vienna in 1883 one of the public life pensioners (by inheritance) visited the exhibition, accompanied by his proud savants and surrounded by a crowd of bareheaded, open-mouthed natives, whose delight in getting a glance at one of imperial-royal family is beyond our comprehension. He listened to the explanations made of the wonders of electricity just as though he understood it all, and in order to be clear on all points he said he would like to see the machine which drilled the fine holes through those long thin wires for the electricity to flow through. During the Frankfort Electrical Exhibition last year some one—we won't say who—was looking at the artificial waterfall, the water for which was pumped by means of electric motors driven with a current generated by the waterfall at Lauffen 100 miles off, and remarked with the usual pride of one who possesses but little knowledge that the water for this fall was brought all the way from Lauffen through those three thin wires.

Thomson-Houston Annual Report. In another column will be found the synopsis of the annual report of the Thomson-Houston Electric Company for the year ended Feb. 1, 1892. An examination of this statement shows that the volume of business of the past year was almost exactly the same as that of 1890, the increase in 1891 being less than one per cent. over that of the preceding 12 months. The cause of this is well understood by those acquainted with the financial conditions of trade during the early part of last year. The unsettled condition of all commercial invesments made it a difficult matter to induce capitalists to invest their money in electrical and similar securities, a state of affairs that was entirely due to the prevailing timidity and distrust of all industrial enterprises. In the latter half of the year, however, capitalists were again reassured of the safety of electrical securities and the business of the company gained very rapidly until it aggregated over $10,000,000 for the 12 months. Notwithstanding these drawbacks, the tremendous activity in the lighting and railway business is well shown by the fact that 118 local companies adopted the Thomson-Houston system of lighting and 59 railway companies equipped their lines with the Thomson-Houston motor. The total number of Thomson-Houston arc lights now in use is over 100,000, and of incandescents over 800,000, while 2,769 cars are equipped with the company's railway motors, a showing that does credit to the managers of the commercial interests of this enterprising corporation.

The Fundamental Patent for Alternating Current Distribution. AS COULD have been predicted, the issue of the fundamental United States patent a few weeks ago for the transmission of alternating currents by transforming them to high potential on the line has called forth comments from those who are affected by it. In another column we publish the views of Mr. R. M. Hunter on this subject. Mr. Hunter appears to be in possession of much information to which the public has no access, as he seems to have been a claimant himself for this invention, and therefore knows much of the history of this patent while it was making its tour through the office. Those who are or who may be affected by this patent will find good matter in Mr. Hunter's contribution. He gives a number of reasons why he thinks this patent is not valid, some of which remind one of the oft repeated story of the general who gave a dozen reasons why he did not fire a salute for His Majesty, the twelfth one of which was that he had no powder. While all the facts he gives are interesting, they do not, however, completely satisfy those who are using or intend to use this system, because it appears that Mr. Hunter claims to be entitled to the patent himself. Should he be able to sustain his claims it will be far worse for the electrical industries than it is now. As it is, the present patent, even if it be sustained, cannot have a much longer life on account of the French patent, but if Mr. Hunter should succeed in geting it, it would give him the control of this very valuable monopoly for 17 years from the present time. The probabilities, however, are that the whole matter will have a history similar to some other cases, namely, that the fight will continue for years, that meanwhile everybody will go on using the invention regardless of any patent, that much paper and time will be wasted, that the lawyers will make lots of money, and that, at the end, everybody will be satisfied except the inventor and his capitalists.

The Gearless Motor. THE most complete and satisfactory report of the actual performance of the gearless motor for electric street car service that has yet been made is that embodied in Prof. S. H. Short's paper before the Chicago Electric Club, reprinted in full elsewhere in our columns. The report contains an admirable summary of the comparative efficiencies of the double reduction, single reduction and gearless types of motors as found in the tests made under the direction of Prof. Short. Well known methods of measuring electrical and brake horse powers were used in the tests and the results as given are strikingly in favor of the gearless motor as an efficient machine under the given conditions of operation. The two strong points urged in favor of this type of motor are the increased efficiency and decreased expense for repairs, both occasioned by the absence of the gearing ordinarily used on street cars. The test reported shows that the greatest efficiency of the gearless motor obtained was 70 per cent., and this when it was delivering from 14 to 16 h. p., the efficiency at small loads, says 2 h. p., being something like 50 per cent. With a load of 14 h. p. the single reduction motor showed an efficiency of 60 per cent. while the double reduction gear, with the same load, brought down the efficiency to a little over 50 per cent. One very interesting feature of the operation of double reduction motors, brought out by this study of the comparative efficiencies, is the rapid falling off in the efficiency after a certain fixed load has been exceeded. In the motor used in this test this load was found to be about 12 h. p., and at this load a maximum efficiency of about 55 per cent. was obtained. With both light and heavy loads the efficiency fell off very rapidly, indicating that the double reduction motor to secure the best results should be operated with medium loads, a fact already recognized in the operation of gear machinery for other purposes. The same tendency is noticed in the efficiency curves of the single reduction and the gearless motors, but the decline at heavy loads is much less gradual and less objectionable. Another point touched upon in this paper is the difficulty of keeping up rail joints on electric railway lines. This is attributed by the author to the unyielding nature of the load carried directly upon the car axle, this being in most cases one-half the total weight of the motor. The other half of the load is carried upon the spring suspension attached directly to the car body. In the Short gearless motor, where the entire weight of the motor is carried upon the car axle, provision is made for relieving the hammer-like blow upon the rails at each joint by the intervention of suitable springs. There can be no doubt that some severe pounding may be caused by very heavy motors not flexibly supported from the axles, a method of suspension not possible when gears are used to transmit the power from the armature shaft to the car axle. Steam railroad engineers have met with similar troubles caused by the sledge hammer blows delivered by the ponderous counterweights of the locomotive driving wheels, the effect sometimes being so serious in this case when trains are run at high speeds as to cause a very noticeable bending of the rails at every revolution of the drivers. The entire treatment of the subject is so practical that the paper forms a most instructive contribution to the literature of electric traction and one that can be read with profit by all street railroad men.

Peculiar Behavior of Oil as an Insulator. NOW that oil is universally recognized as a good insulator, and that its use is not patentable, reports of its shortcomings are beginning to appear which seem to show that, although very good under certain conditions, it has certain peculiar qualities which warn us to proceed slowly with the use of it until we know more about its idiosyncrasies. Prof. Elihu Thomson, who has experimented perhaps more than any one else in this field, noticed during the course of his experiments some curious anomalies which at first could not be understood. He found, for instance, that with very moderate potentials puncture through the oil would occur in some cases through considerable distances, while in other cases the insulation was maintained. His experiments, which are not yet completed, seem to indicate that low periodicities of 125 or thereabouts, and comparatively smooth waves of current, such as are given out by the ordinary alternating current apparatus, will cause puncture over much longer distances under oil than occur with very high period current discharges. In fact in some of the experiments the striking distances in oil have been approximately like those in air, falling not much below. With potentials from a high period machine giving from 3,000 to 5,000 alternations per second, the insulating quality of the oil seemed to be much better, and his experiments show that with high periods and very high voltages the insulating qualities of oil are all that could be desired. One of the most curious effects which he noticed in the course of his researches was that it takes time to break down oil; that momentary contacts are by no means sufficient to cause puncture, but that if the alternating waves are kept on for periods varying from a few seconds to half a minute or more, the oil may break down at last; and, furthermore, that the wider the distance between the electrodes the longer the time it seems to take to break it down. It is suggested that there may exist in the oil conducting particles which arrange themselves in chains very much as iron filings do in a magnetic field; also that there may be some sort of convection which carries electrified oil from the electrodes into the space between them, finally breaking down the oil. He is at present continuing to investigate the subject more fully, and with his well known perseverance we have no doubt he will soon get at definite and reliable results. In order to see whether the time element can be extended, he intends to keep the oil flowing under pressure between the electrodes. To show how curious some of the results are, he found that under certain circumstances potentials which perforated oil at a distance of three-eighths of an inch at other times failed to puncture the same oil at a thirty-second of an inch. Such results certainly show that it is very necessary to investigate the subject more fully before relying too much on the small amount of knowledge we have up to the present time regarding the insulating properties of oil. The law of resistance, which is such a simple one for continuous currents, appears to be a very complicated one when it concerns alternating currents and especially so apparently when these alternating currents are of high frequency and exceedingly high potential. It would be a very valuable contribution to our knowledge of the subject of the insulating properties of oil if those who have the facilities will endeavor to discover its law—if there is any—before we make any mistakes by relying on our present insufficient knowledge of the subject.

ELECTRICAL WORLD PORTRAITS.—No. XXXIII.

ZIPERNOWSKI—DÉRI—BLATHY.

Carl Zipernowski is the son of a merchant, and was born in Vienna, Austria, in the year 1853. After finishing his studies at the high school in Budapest he made a specialty of the study of chemistry and took a position as apothecary, which he held for five years, This profession, however, was not satisfactory to him and he therefore, in 1872, went to the Royal Polytechnic College, where he took up the study of mechanical engineering. During the first years of his studies he was also engaged as draughtsman in the office of the Austrian Government Railway Company. In the second year of his studies he occupied himself chiefly with descriptive geometry, during which time he made a discovery of a new method of some importance for making perspective drawings. His work in this direction was published in the proceedings of the Vienna Academy of Sciences, as well as in book form. He was also specially engaged in problems in kinematics and in the theory of the strength of materials. His work in this direction was often the subject of discussion in the Society of Hungarian Engineers and Architects, and appeared in the publications of that society.

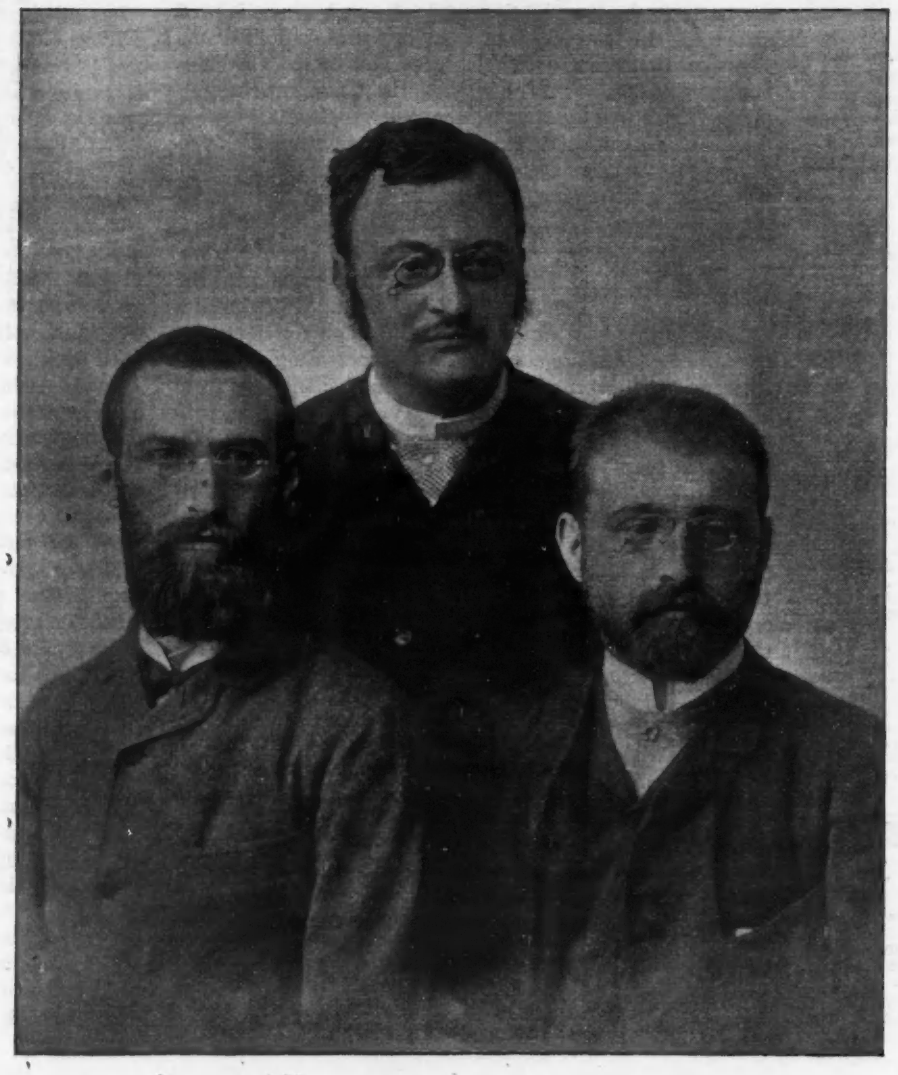
In the year 1877 he took the degree of engineer, and was among the most distinguished of all his colleagues. He then took up the subject of electricity and was engaged during a year in making various electrical apparatus. In the year 1878 he was engaged as an engineer in the firm of Ganz & Co., of Budapest, where he made, during the same year, the first continuous current dynamo in Hungary, also the first alternating current dynamo made by that company, the type which they have continued to build, with some slight modifications, up to the present time.

From that time on he made numerous electrical inventions, partly in connection with his two colleagues, Mr. Déri and Mr. Bláthy, which were also patented in foreign countries. Many of these are well known, and have become of considerable importance. Among them may be mentioned the following: Various forms of dynamos for continuous and alternating currents, including improvements in armatures, and in gearing for driving the dynamos; a dynamo for generating either continuous, alternating or different phased alternating currents, in one or more circuits; self-exciting alternate current machines with compound winding for self-regulation; accumulators; arc lamps; incandescent lamps for use in explosive atmospheres; regulating and distributing apparatus for circuits of various kinds, including high tension distribution; measuring instruments; starting switch for motors; the coupling of transformers in parallel; the ring form transformer with iron on the outside; a method for tempering steel springs by means of electrical currents; transformers for converting continuous into alternating currents and the reverse; alternating current motors; an electric railroad conduit system; details for electric railroads; an electrical soldering iron; an electrical heater; and in the last year various details and systems for inter-urban rapid transit electric railroads. The best known among these inventions are perhaps the system of running transformers in parallel, the iron clad transformer and the recent work in high speed electric railroading.

Max Déri was born in the city of Bacs, Hungary, in the year 1854. From 1872 to 1877 he attended the Polytechnic College at Vienna, and after obtaining the degree of engineer he showed a pronounced liking for electrical science, and made his first researches with induction apparatus. From 1878 to 1882 he was in the service of the Royal Hungarian government as a hydraulic engineer, being occupied in the hydraulic works for the improvements of the rivers Danube and Theiss.

During that time he continued his electrical studies, and in 1881 was sent by the Hungarian Minister of Public Works to Paris to study the Electrical Exhibition. In 1882 he was engaged as an electrical engineer by the firm of Ganz & Co., Budapest, where he has worked in conjunction with Mr. Zipernowski and later with Mr. Bláthy. The name of Mr. Déri is connected with a number of inventions in electrotechnics, and in most of them he has worked in conjunction with these gentlemen. Among the most important patents granted to him are for a self-exciting alternating current dynamo in 1882; a rotating secondary generator, 1884; an improved induction apparatus for the transformation of electric currents (transformers), 1885; improvements in regulating alternating currents, 1886; dynamo compensator, 1885; improvements in distributing electricity, 1885; electric current converting apparatus, 1888; improvements in distributing electric energy, 1888; improvements in alternating current motors, 1889. Mr. Déri personally superintended the construction of the first alternating current central stations with transformers of the Zipernowski-Déri-Bláthy system in Luzerne, Milan, Rome and numerous other places for the firm of Ganz & Co., until 1889, when a new company, the International Electric Company, was formed in Vienna, of which Mr. Déri was chosen managing director. In this position he has constructed several central stations, among them one in Vienna.

Otto Titus Bláthy was born in 1860, at Totis, a small provincial town in the kingdom of Hungary, where he received his early education. In 1871 he went to Vienna, where he attended the High School and Polytechnicum, graduating as mechanical engineer in 1881. He was then engaged for two years in the machine and locomotive works of the Hungarian State Railways at Budapest, and while there designed some machinery for the Bessemer Steel Works. In 1883 he was engaged by Messrs. Ganz & Co., at Budapest, as mechanical and electrical engineer, which position he holds at the present time. Here he very soon succeeded in developing the dynamos built by that firm to a very high degree of perfection; later on he gave his attention, conjointly with Messrs. Zipernowski and Déri, in inventing and developing the now well known system of distribution with alternate current transformers. The Patent Office reports bear testimony of the work done by him in this direction, among which several types of transformers, meters and alternate current motors deserve special mention. Owing to the lack of time and inclination, he did not enter the literary field to any extent. Several letters to the London *Electrician* constitute the only literary contributions by which he became known to the reading public. To American electrical circles he is known from a visit to the United States in 1886. To the chess world Bláthy is known as one of the most original composers of chess problems.



Otto T. Bláthy Z. Zipernowsky M. Déri

Power Transmission at Niagara.

BY F. E. PRITCHARD.

We are constantly hearing a great deal said of the transmission of the great power of Niagara to Buffalo by various schemes, and some very practical ideas are constantly being brought out and discussed with a view to solving the problem; but to a person on the ground and engaged, as the writer is, with the work already in hand a question arises that has received very little notice up to the present time, viz., the transmission of the power from the water-wheel to the generator or other medium of longer distance transmission.

In the development of power here up to the present time it has been a very difficult matter to obtain a satisfactory means of transmitting from the wheel to the surface of the ground.

I think that I may say without fear of contradiction that the rope drive is far in the lead for this purpose, but this also has its serious faults. There are places here, however, where it is being used under conditions that, practically speaking, prevent the use of any other known system.

One of these places is at the station of the Brush Electric Light and Power Company. A brief description of this may be of interest to the readers of THE ELECTRICAL WORLD.

The station is located over the mill tracks of the New York Central & Hudson River Railroad, and is, in consequence farther from the water-wheel than would otherwise be the case, but not as far as the water-wheels will be below the surface in the new power plant now in course of construction here, viz., the great tunnel.

A line shaft runs through the building with one end extending over the wheel pit. To this are belted the generators in the usual manner. Seventy-five feet below this shaft is located the water-wheel, a 15-inch horizontal Victor wheel, in a case of boiler iron, its shaft extending to bearings supported by bridge-trees, which in turn are carried by the foundation I-beams that support the wheel case. This shaft carries an iron pulley 40 inches in diameter, and of face sufficient to admit 12 grooves of proper size for ¾-inch rope. The pulley on the driven shaft above is of wood 70 inches in diameter to match the driver. The tight or working side of the ropes are perfectly perpendicular, and are free from the driver to the driven pulley. The slack side has two idlers or guide pulleys, one of which is situated immediately below the driven pulley and the other is about 20 feet above the driver. An idle pulley or tightener is adjusted in a running frame in line with the driven pulley and upper guide pulley, "the purpose of which is to care for the slack of rope," and this tightener is held in position pulling against the rope by a system of pulleys and weights.

In putting on the rope the following course is taken: Commencing at one side of the pulleys the rope is passed around from the driver to the driven pulley in every alternate groove until the opposite side is reached, thence around the tightener pulley in the running frame, which is hung on an incline in such a manner that its discharging side is in line with the side of the driven pulley from whence we started. The remaining grooves are then filled, and the ends of the rope are spliced in position around the idler. Thus it is readily seen that there are two strands of the rope on the idler at all times. The object of this is to have one solid piece of rope on the idler at the same time that the splice is, so as to relieve the spliced piece of the strain of the idler.

This system is giving far better satisfaction than has the upright shaft to those who have tried both. The extreme weight of the latter makes it a very difficult matter to provide a suitable bearing to support it. The side or guide bearings are easily cared for.

The question of pulleys is one of importance in the use of the rope drive. Iron pulleys are preferable for the following reasons: They will not warp or get out of balance when once properly adjusted. The rope will last longer. That iron and wood will last better than wood and wood when running in contact with each other is an established fact, and, as rope is a woody substance, it follows that the rule is applicable here. But the main reason that the rope lasts better when running on iron pulleys is due to the fact that the iron pulley can be made more uniform in the depth and shape of its grooves. With an iron lathe the grooves, by the adoption of a system, can be turned practically exact of an even depth and size. With a wood lathe this is difficult, almost impossible. This an extremely important question, for if the grooves are not of a uniform depth they act as a differential pulley, and the result is very disastrous to both rope and pulley.

This question was first brought to the notice of the writer at the station of the People's Light and Fuel Company, at Moline, Ill. A system since destroyed by fire was in use there as follows: Diameter of driver, 10 feet; diameter of driven pulley, 5 feet; speed of driver, 200; face, 12 grooves for one-inch rope. This was duplicated for reserve.

After running about 30 days one or more of the grooves in the driven pulley was fully one inch deeper than the rest. Let us see what caused it. This pulley ran at a speed of 400 revolutions per minute. We will assume for convenience that 11 of the grooves were precisely 60 inches in diameter and that one was $59\frac{11}{12}$ inches. As the circumference of a circle is about three times the diameter, it will be seen that the rope running in the groove No. 12 has about $\frac{1}{24}$ less distance to travel than the remaining eleven. The speed $400 \times \frac{1}{24}$ inch $= 37\frac{1}{2}$ inches, or the distance that the rope must slip in groove No. 12 in one minute, 187 feet 6 inches every hour, or 4,500 feet every 24 hours. Is it to be wondered at that the groove gets still smaller. This is not all, as the rope is also being worn by the slippage, and the remaining 11 ropes have to carry all the load including that caused by the slip of No. 12.

A cotton rope was tried at the above described Niagara plant, but did not do the work that a manila rope has done. It was recently replaced by an ordinary manila costing but

12 cents per pound and this is standing the test thus far very satisfactorily.

This drive is at present carrying with ease one 30-light 2,000-c. p. machine, two 65-light 2,000-c. p. Brush arc machines and one 600-light 16-c. p. Brush alternator. In the opinion of the writer it would carry as much more without strain or slippage. That rope drive is to figure conspicuously in the development of power at Niagara in the future remains no longer a doubt in the minds of those who have given it a fair and impartial trial.

The Kinematics of the Rotary Field.

BY JOHN F. KELLY.

When M. Dolivo-Dobrowolsky came before the public with his multiphase motors he, in a lengthy paper, attempted to show by mathematical reasoning the superiority of his type to the ordinary two phase Tesla motor. In the course of the argument he advanced some most revolutionary propositions in kinematics which, strange to say, have been accepted almost without question. In fact, so far as I am aware, no one but Mr. Steinmetz has questioned their validity. I do not propose here to discuss the question as to the relative merit of the two and three phase motors, nor even to enter upon the subject of the distribution of magnetism as affected by varying permeability; I will deal only with the kinematic arguments advanced by Dobrowolsky and accepted by his followers. The question of the variation of permeability, though highly important, is foreign to the main argument and was not indeed advanced in Dobrowolsky's paper. It seems to have been introduced by Dr. Pupin as an afterthought at a recent meeting of the Institute of Electrical Engineers to offset Mr. Steinmetz's criticism. Dr. Pupin's final decision appeared to be in effect that, while two simple harmonic motions of equal amplitude at right angles and differing in phase 90 degrees may compound into a uniform circular motion, two simple harmonic magneto-motive forces at right angles and differing in phase 90 degrees cannot produce a uniform rotating magnetization *because of the varying permeability.*

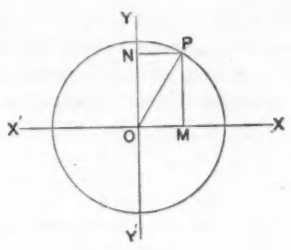


FIG. 1.

This is doubly beside the question, for Dobrowolsky attempted to show that three pure sine waves give a more uniform resultant than two, a question of kinematics, not of physics, and no one has even tried to prove that when permeability is taken into account that three magneto-motive forces do produce a uniform magnetization. Dobrowolsky's argument is in fact as to the compounding of magneto-motive forces, not of magnetizations.

The question then is purely kinematical; and in the kinematical form, as soon as the terms of the proposition are understood, the answer whether of plain common sense or of mathematics is direct and obvious. Fig. 1 represents a circle of radius R with two diameters XX', YY' at right angles. P is a point moving uniformly around the circle. Its distance from the centre O measured parallel to XX' will at any instant be equal to the portion of XX' included between O and the foot of the line drawn through P parallel to YY', while at the same time its distance as measured parallel to YY' is equal to this same perpendicular, or to the intercept on YY' made by a line drawn through P parallel to XX'. The motion of the point P may therefore be regarded as compounded of the motion of the point M, the foot of the perpendicular drawn through it to XX', and that of N, the foot of the perpendicular to YY'. But in the circle of unit radius these two perpendiculars are respectively the sine and cosine of the angle POX, and in the circle of radius R are evidently equal respectively to R sin POX and R cos POX. The distance of the point M is therefore at any instant equal to R cos POX, and that of N is equal to R sin POX. Or since the cosine of any angle is equal to the sine of the same angle less 90 degrees, we have R cos $POX = R$ sin (POX — 90 degrees), which is equivalent to saying that the motion of the point M lags behind that of the point N 90 degrees. Similarly calling the angle POX θ and letting OP, OX and OY be represented both in magnitude and amount by ρ, α and β we have

$$\rho = \alpha \cos \theta + \beta \sin \theta$$

or

$$\rho = \alpha \sin (\theta - \tfrac{1}{2}\pi) + \beta \sin \theta.$$

These equations as evidently represent two simple harmonic motions of equal amplitude at right angles with a phase difference of 90 degrees, as they do the motion of the point P in the circle. We may therefore regard it as settled that simple harmonic motions of equal amplitude at right angles and with a phase difference of 90 degrees combine to produce a uniform circular motion.

How then does Mr. Dobrowolsky manage to arrive at the result that the amplitude of the resultant motion varies 40 per cent.? He begins by assuming that the two harmonic motions are not at right angles, but in the same line. But even this will not meet his wants, for according to all the ordinary rules of compounding motions the result of compounding any two simple harmonic motions of the same period in the same line is another simple harmonic motion. For instance, in the equation

$$\rho = \alpha \cos \theta + \beta \sin \theta$$

if we suppose the two motions to take place in the same line β becomes equal to α, and the equation reduces to α (cos θ + sin θ) = 2 α sin ($\theta - \frac{1}{4}\pi$) cos ($-\frac{1}{4}\pi$) = $\sqrt{2}\,\alpha$ sin ($\theta - \frac{1}{4}\pi$).

But this last expression is from its form that for a simple harmonic motion midway in phase between the two primitive ones and in amplitude equal to either multiplied by $\sqrt{2}$. We arrive at the same results by the use of graphical methods. Let $AA'A''$ and $BB'B''$ be curves representing two wave motions in the same direction, and 90 degrees apart in phase. Distances measured along OX represent the time elapsed from the beginning of the period considered, and distances parallel to OY the displacement of the moving point. These distances correspond respectively to distances measured around the circumference and along one of the axes in the first case. If now we compound these two curves by adding together the ordinates corresponding to the same instant of time, due regard being paid to the signs, we get the curve $CC'C'$. This curve is midway between the other two, and its maximum ordinate is equal to the maximum ordinate of either of the others multiplied by $\sqrt{2}$. Consequently, the compounding of two directly superimposed wave motions of equal amplitude and 90 degrees apart in phase gives rise to another similar wave motion midway between the two original waves and in amplitude $\sqrt{2}$ times greater. The magnetization produced by two such magneto-motive forces would not vary 40 per cent., but would pass through zero. Mr. Dobrowolsky, however, pays no attention to signs, and adds the ordinates indifferently on which ever side of the axis OX they may lie. What justification he has for doing this I have yet to learn. He could not do otherwise were the currents producing the magneto-motive forces commuted.

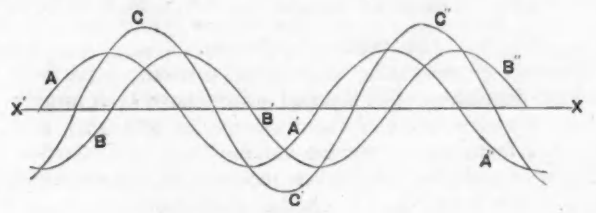


FIG. 2.

It has been suggested, however, that it is more correct to consider the two sets of magnetizing coils as producing a series of magnetic waves along an indefinitely long bar than as combining to produce magnetic rotation; and that on this assumption, while Mr. Dobrowolsky's analytic methods may not be correct, his results substantially are so. Before going into this it will be well to pay attention for a moment to the triple use made of the wave motion curve. The curve (Fig. 3) may in the first place represent the displacement of the moving point with time, the time being measured along OX, and the ordinates showing the amount of displacement from the position of rest along the straight line on which it moves; in the second place, it may serve to show a set of stationary waves such as those in a vibrating string. In the case of the string the curve may be taken to represent the form of the string at the moment of maximum displacement in one direction. One-half period earlier or later, the same set of waves would be represented by the dotted curve. When the curve represents stationary waves, then distances along OX represent lengths, and the distance between any two corresponding points such as two consecutive crests is the wave length. The position of the nodes, the points at which the curve cuts OX is fixed, and all the ordinates vary, together passing through zero simultaneously. In fact for each ordinate a time curve might be constructed, and all these curves would agree except in amplitude, the maximum amplitude corresponding to the ordinate at the middle of the loop, and zero amplitude to the node.

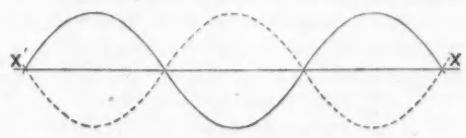


FIG. 3.

The third use made of the curve is more difficult to grasp. It is used to represent the instantaneous values of a set of progressive waves. In this case we must regard, after the lapse of a half period, every point on the curve to have moved forward parallel to OX through a half wave length. The curve at the end of the half period would be as shown in the dotted line, Fig. 3. To this extent it would appear to be similar in representation to a set of stationary waves. But if we choose an intermediate time for comparison the difference becomes marked. Let us take one-eighth period: at the end of the one-eighth period all the ordinates of the stationary set of waves will have altered their values to those shown in the smaller curves, Fig. 4, but will have maintained their position; while on the other hand, all the ordinates of the set of progressive waves will have maintained their original magnitudes, but will have moved forward one-eighth wave-length as in the curve. In the stationary set of waves there is a certain set of points at which the displacement is always zero, and another set of points, the centres of the loops, at which the displacement is always maximum, the value of this maximum being itself a periodic function of the time. In the progressive set of waves, on the contrary, the maximum value of the displacement is independent of the time, but as with the position of zero displacement, its position is a periodic function of the time.

Now we may consider the two sets of magnetizing coils as giving rise to two sets of stationary magnetic waves, the nodal points of the one set corresponding to the midpoints of the loops of the other, and one set lagging in phase 90 degrees behind the other. The question is as to the nature of the resultant of these two sets of waves. It will be evident at once that when the ordinates of either set of stationary waves have attained their maximum value, the curve representing it must coincide with that of the resultant, for at that moment all the ordinates of the other set of waves are at zero. The resultant motion, therefore, is progressive in character, and is at least at times equal in amplitude to the amplitude of the stationary waves. It remains only to determine whether its amplitude is constant. To do this completely, it would be necessary to plat the values of the stationary waves for each instant and separately compound them. In this way we should get a set of wave figures arranged one in advance of another, and at every quarter period coinciding with the maximum curves of the stationary waves. To do this would, however, involve enormous labor, and would probably be no more convincing than platting for a single epoch, that at which Dobrowolsky claims the resultant motion attains a maximum amplitude. This is the moment at which the ordinates of the two stationary waves are equal. I have, therefore, platted the two stationary waves for this epoch, and from these two their resultant (Fig. 4). It will be seen at once that it differs in nothing save position from the two stationary waves which represent respectively epochs one-eighth period either side of it. Consequently, it appears that in the case of an indefinitely long iron bar, two sets of coils uniformly distributed and traversed by equal currents differing 90 degrees in phase will give rise to a set of progressive magnetic waves of constant amplitude.

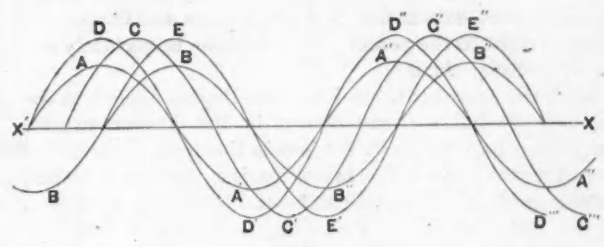


FIG. 4.

We arrive at the same results, only more quickly and generally, if we resort to algebraic analysis. The equation to one of the stationary waves may be written

$$Y = A \sin \frac{2\pi}{T} t \sin \frac{2\pi}{1} X,$$

and that to the other

$$Y = A \cos \frac{2\pi}{T} t \cos \frac{2\pi}{1} X,$$

T being the length of the period and 1 the wave length. Adding these two together we get

$$Y + Y' = A \left(\sin \frac{2\pi}{T} t \sin \frac{2\pi}{1} X + \cos \frac{2\pi}{T} t \cos \frac{2\pi}{1} X\right);$$

or

$$Y + Y' = A \cos \left(\frac{2\pi}{T} t - \frac{2\pi}{1} X\right).$$

Putting $T = \frac{1}{v}$ and substituting in the last equation we get

$$Y' + Y = A \cos \frac{2\pi}{1} (vt - X).$$

But this expression is the equation to a set of progressive waves of amplitude A, and velocity of propagation v.

It has occurred to me that Mr. Dobrowolsky's mistake may in part be due to his confounding the space and time waves. Referring again to the diagram Fig. 4 it will be seen that the maximum ordinate of the space waves at one-eighth period is equal to the ordinate where the two time waves intersect. The space ordinate at this point of course at this instant is reduced in the same degree as the maximum ordinate. If, therefore, the ordinates of the time waves at one-eighth period should be added together instead of the corresponding space ordinates, the resulting ordinate would exceed the maximum ordinate of either original curve in just the same degree that Mr. Dobrowolsky thinks variation takes place. In other words, Mr. Dobrowolsky's addition at one-eighth period is as if he added together the maximum ordinates of the space waves, ignoring the fact that these ordinates are one-fourth wave length apart in space.

As I said in the beginning, I am not here making any claim to demonstration of the superiority or even equality of the two to the three-phase motor; but I think I have abundantly shown that the reasons so far advanced in support of the alleged superiority of the latter are not valid. If there exist any other reasons I shall be glad to hear of them.

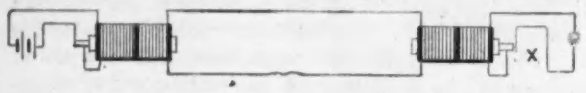
STANLEY LABORATORY, April 7, 1892.

The Deprez and Carpentier Patent on the Transmission of Power by Step-Up and Step-Down Transformers.

BY R. M. HUNTER, M. E.

The publication of the substance of the Deprez and Carpentier patent and the editorial thereon in THE ELECTRICAL WORLD of March 26, 1892, has made me deem it but proper and just to the public to make known some facts relative to this patent. Upon its face the patent appears to cover the converter system of electrical transmission broadly. In my opinion the patent is totally invalid, and should never have been issued. The following facts will show this to be true.

The patent is based upon the French patent of March 3, 1881, and it is only in view of that patent that the United States patent can have existence. The French patent is extremely vague and indefinite, and sets out a different structure from what is patented here. It requires two rheotomes and induction coils connected as shown in the illustration. In making the United States application, the attorney ingeniously left off the rheotome at the distant



SKETCH ILLUSTRATING THE DEPREZ AND CARPENTIER PATENT.

station X. The French patent has no illustration, but the language of the specification indicates that the induction apparatus at the transmitting and that at the receiving station are identically the same, only inverted and that both have interrupters or rheotomes. Such a device is inoperative according to the sworn testimony of the expert of Deprez and Carpentier who tested it. Besides it is nothing more than what is shown in the United States patent granted to the Frenchman Maiche, No. 243,364, and dated June 28, 1881 (filed in 1880), the device of which patent is also inoperative. By leaving off the distant rheotome, alternating uniform currents were obtainable and an operative device was evolved out of the inoperative one. For reasons which it would take too much space to explain in detail, the Patent Office became uncertain as to the standing of the application, and by error allowed it to go to issue. The application should still be pending. If the French patent date is not available Deprez and Carpentier have no right to the patent, and this date is certainly not available under the law.

Next, the patent is invalid because Deprez alone was the inventor of whatever was shown in the French patent. Carpentier has no right to join in the application in the United States patent. The invention is a process or method —not a mechanical contrivance—and is defined as set out in the claim of the patent. Deprez and Carpentier rely upon their French patent, No. 141,464, the date of filing of which was March 3, 1881, which, it is alleged in their behalf, discloses the invention of the United States patent. Now, referring to that French patent, the following statement is found:

"The invention is based upon a fact, the existence of which, one of us, Marcel Deprez, has discovered."

Examining, then, this patent, to ascertain what is this "fact" that M. Deprez claims to have discovered, we learn that it is the very operation of the invention which he claimed with M. Carpentier as the joint invention. This alleged "fact" is, that if a current of electricity of high tension is sent through the fine wires of a Ruhmkorff coil, it will produce, by its inductive influence, a current of lower tension in the large wire. This is exactly what Deprez and Carpentier base their claim upon in the present patent, and if it is the "fact" that was discovered by Deprez, there is no joint inventorship with Carpentier, and these parties have no standing whatever, and the patent is invalid.

The patent is invalid because it was applied for two years after a public use in this country. This can be proved easily enough. Affidavits and testimony already given make this point undoubted.

In addition to the above, I would say that an interference was prosecuted between Deprez and Carpentier, Gaulard and Gibbs and myself upon the very wording of the claim of the Deprez and Carpentier patent (then an application). The board of examiners-in-chief and the commissioner held that the interference could not be based upon the Deprez and Carpentier application, because they showed a different structure than the Gaulard and Gibbs patent, and that the issue could not be broader than the claims of the latter patent. This reduced the issue to the exact structure of the Gaulard and Gibbs patent, and threw out the Deprez and Carpentier application and evidence, and all of my early reductions to practice which corresponded to the structure of the patent as issued. It was my understanding that the Deprez and Carpentier application was to have been put into interference with my application on this generic claim because I showed substantially the revised apparatus of Deprez and Carpentier in one of the numerous drawings of my application which was filed more than a year ahead of the application of Deprez and Carpentier. By some oversight this second interference was not declared, and the Deprez and Carpentier patent was issued. This, of course, will not prevent the interference between Deprez and Carpentier and myself being prosecuted. It is interesting to know that when the interference was in progress, and before any testimony was taken, Deprez and Carpentier made a motion to dissolve the interference because none of the other parties could take their date of invention back of the date of the French patent.*

My invention was within three months of the French date. Mr. Seely, the examiner of room 87 in charge, denied the motion because he was not satisfied that the French patent did really set out the invention as claimed by Deprez and Carpentier in this country some eight years later, and after seeing what others had done. Had the French patent shown the invention, the interference *must* have been dissolved then. The Patent Office was not satisfied that the French patent did show the invention, and hardly knowing what to do, forced us to proceed, leaving it to chance that we should settle what the French patent really did amount to, it being the only evidence in behalf of Deprez and Carpentier as to date of invention. After the muddle and disposition of the first interference, the application was, by an oversight and wrongly, allowed to go out of the Patent Office without giving me the opportunity of contesting their right to the broad claim. We are therefore not through with that patent, and expect to show the matter up fully. Any way we may look at the Deprez and Carpentier patent it is not worth the paper it is written upon except as a scarecrow to those who do not know the inside of the matter. I am prepared to substantiate every statement made above.

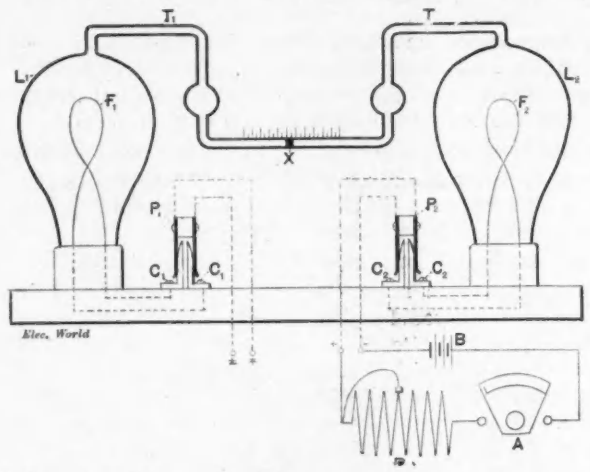
*See Rule 75 of the Rules of Practice.

A Thermal Method of Measuring Periodic Currents.

BY ALBERT L. CLOUGH.

Methods of measuring alternating currents or periodic energy dependent upon thermal effects have been largely resorted to on account of their theoretical simplicity and freedom from unwarrantable assumptions. The Cardew voltmeter and the calorimeter methods of dynamo and transformer testing may be cited as examples.

The following "null" thermal method for the measurement of periodic currents may be of interest, and possibly may even be of practical application in cases in which it is necessary to avoid increasing the time constant of the circuit by the instruments added, but where the addition of an appreciable instrument resistance would not be detrimental.



A THERMAL METHOD OF MEASURING PERIODIC CURRENTS.

In the accompanying diagram L_1 and L_2 are two exactly similar incandescent lamps, of resistance suitable for the range of currents desired to be measured. The bulbs of these two lamps are connected by the bent tube T, forming what is virtually a differential thermometer of the well known type, furnished with a liquid index at X. The terminals of the lamps are brought out to the contact faces C_1, C_1, and C_2, C_2. There is provided in addition a battery, B, consisting of a cell or two of accumulators, a direct current ammeter, A, and a readily adjustable resistance, R, the value of which need not be known.

Now, in such an arrangement as this, if we assume the lamps to be thermally and electrically identical, and pass currents of equivalent intensity through the two filaments, the liquid index should not move, owing to the equal rate of expansion of the gas in the two bulbs; if, however, unequal currents pass in the two filaments, of course the index should move away from the filament traversed by the greatest current.

The principle of the method is then the balancing of the unknown periodic current by a thermally equivalent direct current which is measured directly by the ammeter A.

In using the instrument as illustrated, the filament F_1 would be cut into the alternating circuit by means of the circuit preserving clip P_1, and simultaneously filament F_2 would be inserted into the battery circuit by clip P_2. A balance would be effected by varying the resistance R, when the immediate reading of the ammeter would give the square root of the mean square of the periodic current.

By reversing the clips, thus causing the alternate current to pass through filament F_2 and the direct current to traverse filament F_1, a second determination of the periodic current might be made, thus making it possible to eliminate errors due to slight thermal differences of the two bulbs.

It does not seem impossible to the writer that a suitable modification of this principle might be used with advantage in connection with experiments on currents of rather high frequency, as it involves a minimum increase in the self-induction of the circuit.

Application of the Weston Voltmeters and Ammeters to Practical Electrical Measurements.—IV.

BY H. MASCHKE, PH. D.

§ 25. *Testing Ground Leaks in Electric Light Plants.*—The examples given in the above paragraphs show that the Weston voltmeter is very well adapted to test for and locate earth connections in lighting plants. If an insulation resistance of a circuit amounting to 500,000 ohms can be measured exact to three per cent., and one of 1½ megohm

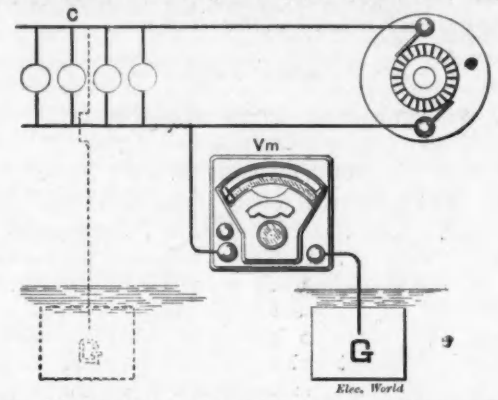


FIG. 30.—MEASURING THE RESISTANCE OF A GROUND LEAK.

exact to ten per cent., the measurements will be perfectly satisfactory for all practical purposes.

The connections for determining the resistance of a ground leak are illustrated by Fig. 30. One binding post of the voltmeter is connected to some point of the light circuit, and the other one to earth (preferably to the water pipes). Let the reading be V_1; let the difference of potential between the positive and negative lines be equal to V, and let r be the resistance of the voltmeter. Now suppose there was a more or less direct ground connection at some unknown point C, then the resistance R of the ground connection between C and G is, according to the formula in last paragraph, equal to:

$$R = r\left(\frac{V}{V_1} - 1\right) \text{ ohms.}$$

If for instance the ground connection is a dead ground, then V will be found to be equal to V_1 and R will then be equal to zero.

If there is no current in the circuit to be tested for a ground leak, a battery of about 20 volts (Fig. 31), consisting of dry elements, is inserted in series with the voltmeter. Then $V = 20$, and a resistance of 100,000 ohms, producing

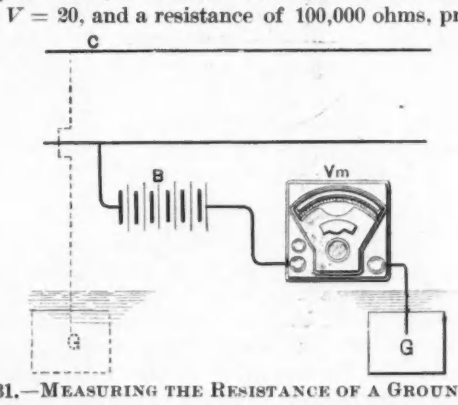


FIG. 31.—MEASURING THE RESISTANCE OF A GROUND LEAK.

a deflection of about three scale divisions, may be measured with an accuracy of about four per cent. Ordinarily it is not necessary to extend the range of measurement of the resistance of a fault to more than 100,000 ohms.

If it is known on what side of the circuit the ground connection exists, then the voltmeter should be placed, as shown, on the side which is clear from grounds. If this is not known, then the test should be repeated for both sides of the circuit. When both V_1 and V_2 are zero, then the circuit is free from grounds. In all cases it is preferable to repeat the test for both sides in order to be sure, as the ground may (in arc light circuits, for instance) be somewhere between the two mains as they leave the dynamo. In that case there will be a deflection in both tests. These two deflections will then also indicate, approximately, the location of the fault. For a description of this method of locating grounds, see Sec. 30.

The insulation resistance of dynamos may be measured

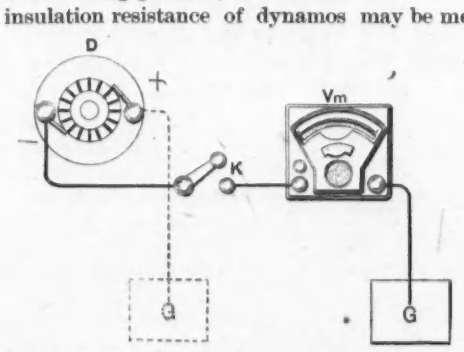


FIG. 32.—MEASURING THE INSULATION RESISTANCE OF DYNAMOS.

in the same way as of grounds. Suppose the pressure to be 150 volts. One binding post of the voltmeter is connected to the proper terminal of the dynamo (while running) and the other one to earth. (See Fig. 32.) An interrupting key is inserted in circuit. If then upon pressing down the key the needle is not deflected appreciably from its zero, then it is certain that the insulation of the second pole of the dy-

namo has a resistance not less than 54,000,000 ohms, the deflection corresponding to this insulation resistance would be $\frac{1}{20}$ of a scale division, which would be distinctly noticeable. The same test should, of course, be made with the other pole as well.

§ 26. *Measurement of the Resistance of the Human Body.** —The resistance of the human body is measured very simply by the method just explained. The jars *J J* (see Fig. 33) are filled with a solution of caustic potash, into which the person whose resistance is to be measured put his hands. First the key *K* is closed and the E. M. F. of the battery *B* is thus ascertained. The key is then opened and the resulting deflection V_1 is read; these values are then inserted in the formula given in Sec. 24, from which the resistance is then calculated.

If for instance $V = 120$, $V_1 = 112.5$ and the resistance r of the voltmeter 18,000 ohms, the resistance R of the human body would be

$$R = 18{,}000\left(\frac{120}{112.5} - 1\right) = 18{,}000 \times 0.07 = 1{,}260 \text{ ohms.}$$

§ 27. *Measuring the Internal Resistance of Batteries. First Method.*—In Fig. 34 *E* is the battery or single cell to

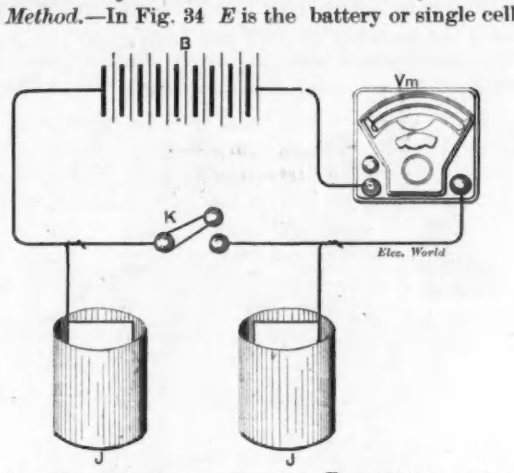


FIG. 33.—MEASUREMENT OF THE RESISTANCE OF THE HUMAN BODY.

be measured; *K* is an interrupting key and *R* a suitable resistance.

If *K* is open, the voltmeter (ranging from 0 to 5 volts) indicates the E. M. F. of the cell, which is, say, *E* volts. Upon pressing down the key *K*, the voltmeter reads the potential difference *e* existing between the ends of *R*. Then the internal resistance r_1 of the cell is equal to

$$r_1 = R \times \frac{E - e}{e} \text{ ohms}$$

If for instance, $E = 1.5$ volts, $e = 1.35$ volts and $R = 4$ ohms, then

$$r_1 = 4 \times \frac{1.5 - 1.35}{1.35} = 0.44 \text{ ohm.}$$

The accuracy of this measurement is not much higher than about five per cent., but for the internal resistance of cells this degree of accuracy is sufficient in most cases.

It may be mentioned here that the internal resistance

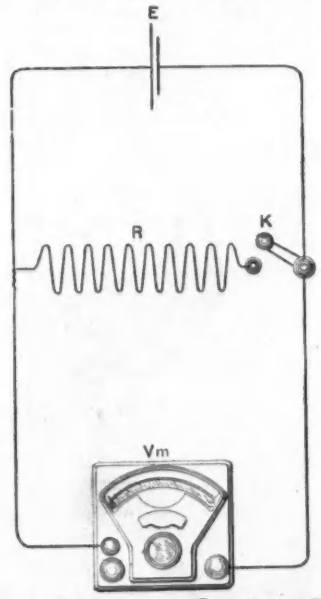


FIG. 34.—MEASUREMENT OF THE INTERNAL RESISTANCE OF BATTERIES.

as well as E. M. F. of cells are no constant quantities, but depend upon the strength of the current passing through the cell. This current, which is equal to $\frac{e}{R}$ may be regulated as required by adjusting *R*. In the example mentioned it is $\frac{1.35}{4} = .34$ ampère. The key *K* is generally kept closed, and is opened only as long as is necessary to measure the value of *E*.

Second Method (Siemens-Froelich).—The cell *E* to be measured is joined up with the resistance R_1 R_2 and r_1, as illustrated in Fig. 35. By means of the key *K* the point *A* may be connected either with *B* or with *C*. If *A* is connected to *C*, r_1 is a shunt to R_1, while upon connecting *A* to *B* the resistance R_2 and r_1 is a shunt to R_1. The voltmeter (0–5 volts) is connected to the terminals of r_1 in both cases.

Now, the value of r_1 is adjusted in such a way that the deflection *V* of the voltmeter remains unaltered whether *A* be connected to *B* or to *C*. Then the resistance of the element *E* will be exactly equal to r_1.

It is advisable to connect an auxiliary known resistance r_2 in series with *E* for the proper regulation of the cur-

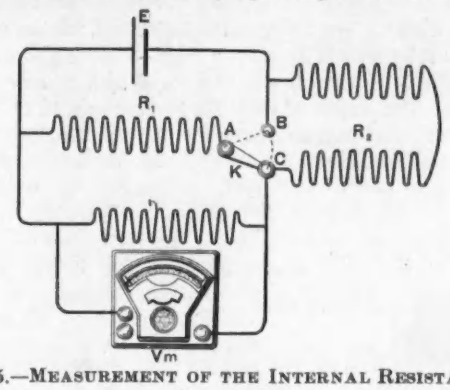


FIG. 35.—MEASUREMENT OF THE INTERNAL RESISTANCE OF BATTERIES.

rent strength; this must be deducted from the value of r_1. If the resistance of the cell is known approximately, it is best to make R_2 equal to about one and a half times the sum of r_2 and the internal resistance of the element, and to make $R_1 = \frac{1}{2} R_2$.

The following example will illustrate the method. If it is known that the resistance of the cell is about 1 ohm, then make $r_2 = 5$ ohms.

$$R_2 = 1.5\,(1 + 5) = 9 \text{ ohms,}$$
$$R_1 = \tfrac{1}{2} R_2 = 4.5 \text{ ohms.}$$

If then r_1 must be made equal to 6.2 ohms, in order to obtain no variation of the deflection of the voltmeter upon interchanging the connection of *A* with *B* and *C*, the resistance of the cell will be

$$6.2 - 5 = 1.2 \text{ ohms.}$$

An error of $\frac{1}{10}$ of a scale division will produce an error of about 0.5 per cent. in the value of r_1.

Half-Deflection Method.—The cell or battery, the unknown resistance of which may be *R* ohms, is joined up in series with a millivoltmeter ranging, for instance, from

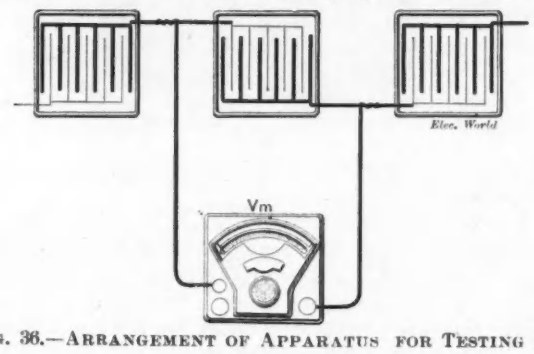


FIG. 36.—ARRANGEMENT OF APPARATUS FOR TESTING ACCUMULATORS.

0–0.04 volt and with a suitable resistance R_1 of such an amount as to produce nearly the whole scale deflection. Then the resistance R_1 is increased to R_2 ohms, so that exactly half the former deflection is obtained. Then there will be, if *r* is the resistance of the milli-voltmeter:

$$R = R_2 - (2\,R_1 + r) \text{ ohms.}$$

If, for instance, $r = 1$ ohm, $R_1 = 16.25$ ohms, $R_2 = 35.5$ ohms, then $R = 35.5 - (35.5 + 1) = 2$ ohms.

As the polarization of a cell depends on the strength of the current flowing through the cell, a certain error is caused by this fact in this method, and this error is much higher than the one caused by the admissible error in the readings of the millivoltmeter. Nevertheless, this method is accurate enough for practical work.

D.—MISCELLANEOUS APPLICATIONS.

§ 28. *Testing Accumulators.*—The voltmeter is particularly well adapted for accumulator work, especially for the examination of the single cells. The great advantage which the Weston instrument offers in this respect will indeed be highly welcomed and appreciated by every electrician.

The examination of the single cells, which ought to be made at least twice a week, was heretofore very often carried

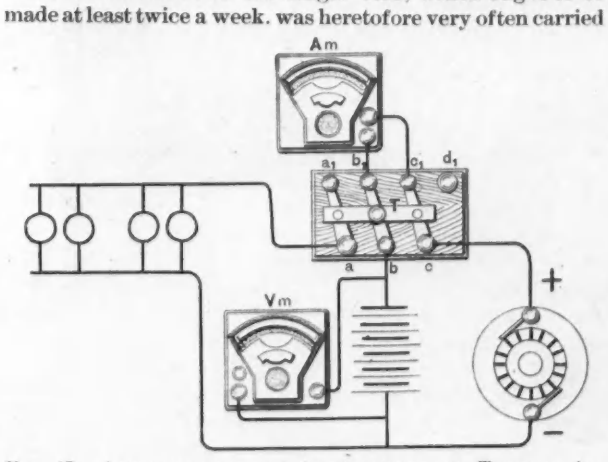


FIG. 37.—ARRANGEMENT OF APPARATUS FOR TESTING ACCUMULATORS.

out by a small 2-volt incandescent lamp which was attached to the terminals of a single cell, and the degree of brightness of this lamp was taken as an indication of the state of the cell. It is unnecessary to say how poor a method this is. If, however, the Weston voltmeter, which is just as convenient (ranging from 0 to 5 volts), be used, instead of the incandescent lamp, the voltage is read directly to fractions of $\frac{1}{100}$ of a volt.

In charging a secondary battery it is an important point, as is well known, not to exceed a certain maximum charge, because otherwise the battery will be damaged and most of the current wasted, more than 90 per cent. of it being consumed in developing oxy-hydrogen gas. None of the methods for ascertaining the limit of charge, as, for instance, watching the development of gas bubbles, the density of the acids, etc., is as accurate and more convenient than to observe the pressure at the terminals by means of the voltmeter. The charging is continued until the voltmeter indicates the maximum pressure allowed for the battery (ordinarily about 2.5 volts per cell) and is then stopped. On discharging, also, it is certainly more reasonable to determine the limit of the discharge from the indications of the voltmeter than from the decrease of brightness of the incandescent lamps. The discharging is stopped when the voltmeter reads 1.85 or 1.80 volts per cell, according to the requirements made by the makers.

The charging as well as the discharging current is measured by means of an ammeter. At the beginning of the discharge the connections with the ammeter must be reversed, the direction of the current being reversed, while no change is required for the connections of the voltmeter.

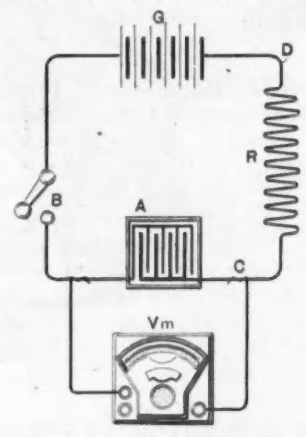


FIG. 38.—ARRANGEMENT OF APPARATUS FOR TESTING ACCUMULATORS.

It is convenient to arrange the apparatus as shown in Fig. 37. For charging the switch *T* is turned so as to connect b_1 to *b* and c_1 to *c*. For discharging the switch is moved so as to connect *a* to b_1 and *b* to c_1. The ammeter connected to *b* and c_1 is then always properly connected.

In case a single accumulator cell is to be tested more particularly, all measurements (electromotive force, internal resistance, voltage at terminals, etc.) may be carried out with one voltmeter (0 to 5 volts) by using the following arrangement (Fig. 38):

Let *A* be the accumulator to be charged from the current generator *G*, *R* a resistance of one ohm; for instance, if the circuit is closed at *B* and the voltmeter attached to *B* and *C*, as shown, then the voltmeter will give the voltage *e* at the terminals of the accumulator *A* while charging. By shifting the connections of the voltmeter to *C* and *D*, the strength *C* of the current passing through *A* is found (see Sec. 19), and if the voltmeter is connected again to *B* and *C* after opening the key at *B*, the voltmeter indicates the electromotive force *E* of the accumulator.

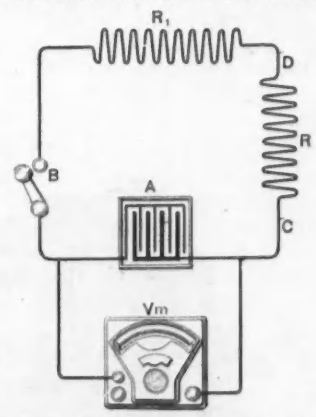


FIG. 39.—ARRANGEMENT OF APPARATUS FOR TESTING ACCUMULATORS.

If r_1 is the internal resistance of the accumulator then during the charge,

$$e = E + r_1 \times C, \text{ or } r_1 = \frac{e - E}{C}.$$

During the discharge through a resistance R_1 (Fig. 39), the measurement is the same, but then

$$e = E - r_1 \times C$$
$$\text{or } r_1 = \frac{E - e}{C}.$$

If, for instance, during the charge $e = 2.35$ volt, $E = 2.20$ volt and $C = 5$ ampères, then

$$r_1 = \frac{2.35 - 2.20}{5} = \frac{0.15}{5} = 0.03 \text{ ohm.}$$

A Cable Transformer.

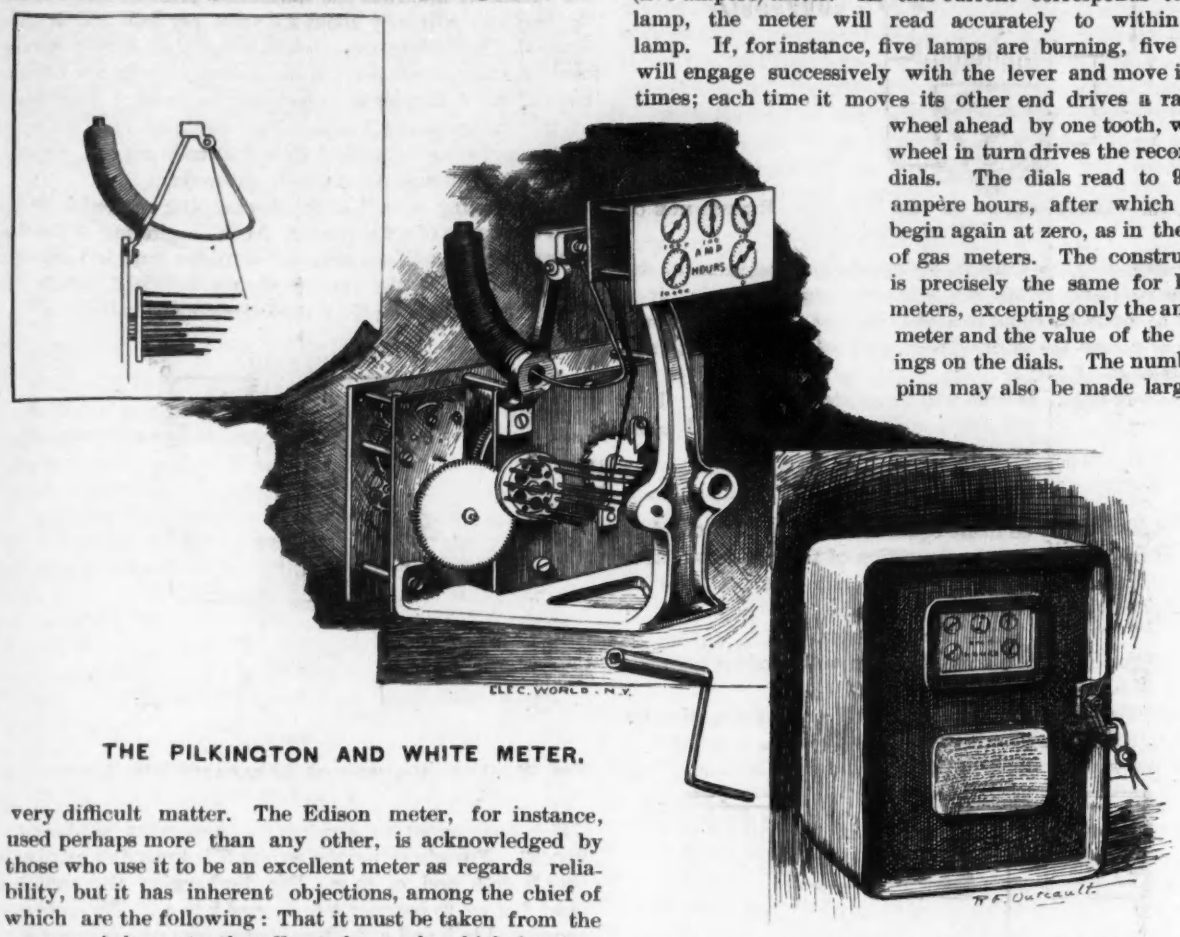
A contemporary gives the efficiency of a 150 h. p. cable transformer of Siemens Brothers, London, as 94 per cent. at full load, 93 per cent. at half load, and 90 per cent. at one-quarter load. The regulation is said to be automatic, and the co-efficient of transformation is claimed to be almost completely independent of the capacity of the secondary circuit. A cable transformer consists, as is well known, simply of an iron cable having the primary and secondary

* See Fig. 2 of an article by P. Loomis, *Electr. Eng.*, Dec. 24, 1890.

copper wires wound around it. It is therefore an open circuit transformer. Being flexible it can be hung up or coiled into a small space. One of the advantages is that, owing to the large radiating surface, it keeps quite cool.

A Practical Electric Meter.

Registering meters are in one respect like an arc lamp, any electrician can devise a new one, it is a question only of how reliable, accurate and substantial it is, as also what its qualities are regarding cheapness and facility of reading. To devise one having a number of these good qualities is a



THE PILKINGTON AND WHITE METER.

very difficult matter. The Edison meter, for instance, used perhaps more than any other, is acknowledged by those who use it to be an excellent meter as regards reliability, but it has inherent objections, among the chief of which are the following: That it must be taken from the consumer's house to the office to be read, which involves much work and much loss of time; bills can therefore not be made out for all the consumers for the first of each month; it reads wrong if the current is accidentally reversed, which not infrequently happens in the Edison three-wire system; futhermore, the consumer cannot read the meter himself on dials, which has been found to be a great objection.

It is to overcome these objections that Mr. Pilkington has devised the interesting little meter shown in the cut, which is now replacing the Edison meter in the Brooklyn plant. The general principle of this meter is that the positions of the pointer of the ampère meter are recorded at regular intervals by a clock mechanism, and are summed up in a recording gear on which the readings are indicated on dials precisely like those of the gas meter, only that they read in ampère hours.

The ampère meter itself consists of a curved solenoid having a light, movable, soft iron core swinging in a vertical plane. Attached to this pointer is a bent lever pivoted at about its middle point on the pointer itself, and capable of rocking in a plane perpendicular to that of the pointer. It therefore follows the pointer but can move sideways. The little wheel shown, having 10 curved pins on it of different lengths, is driven by a 40-day clock which revolves it at a speed of five revolutions per hour. The rocking lever attached to the pointer is just long enough to engage with the wires on this wheel and will be moved through a definite amount by each one of these as they pass under it. As the deflection of the ampère meter pointer is greater or less, there will be a larger or smaller number of pins which will engage with it. For a very small deflection, for instance, the lever will be moved by only one pin—the longest one—and for larger deflections it will be moved by a greater number of them. The length of each pin corresponds to an increase of deflection of half an ampère in the pointer, in a 10-light (five ampère) meter. As this current corresponds to one lamp, the meter will read accurately to within one lamp. If, for instance, five lamps are burning, five pins will engage successively with the lever and move it five times; each time it moves its other end drives a ratchet wheel ahead by one tooth, which wheel in turn drives the recording dials. The dials read to 99,999 ampère hours, after which they begin again at zero, as in the case of gas meters. The construction is precisely the same for larger meters, excepting only the ampère meter and the value of the readings on the dials. The number of pins may also be made larger up to a certain extent, beyond which each pin will correspond to two or more lamps.

It will be seen that it is very simple in construction and contains no delicate mechanism; it requires merely to be placed on a level. It is one of the most satisfactory of its kind that has come to our notice. Neither a short circuit in the mains nor moderately rough handling will injure it. It is made by the Electric Construction and Supply Company, 18 Cortlandt street, New York City, and is the joint invention of Messrs. Pilkington and White.

A New Electric Traveling Crane.

The many advantages of the electric traveling crane over the old styles have brought it quite widely into use in mills and machine shops during the past few years. The flexibility of the motor connections, the fact that when no work is being done no energy is expended, and the absence of all noise are points in its favor. In mechanical cranes the speeds of travel and hoist are fixed, but in the electric crane the motion is entirely under control and can be accelerated, retarded or maintained at any definite speed.

Perhaps the first triple motor crane actually in operation was built by the E. P. Ellis Company, from the designs of H. J. Shaw, and erected in their foundry in Milwaukee. It is said to work very successfully and in some points to be superior to any yet produced.

A general idea of the crane may be obtained from the illustrations, for which we are indebted to *The Iron Age*. Fig. 1 is a perspective view of the trolley and Fig. 2 a plan view of the trolley of a 15-ton crane. The bridge is moved along its tracks by means of a motor near one end, the power being transmitted through gearing to the driving wheels at each end. The trolley carries two motors, placed at one end, as shown, one of which moves the trolley along the bridge, and the other operates the hoisting drum. The crane is fitted with duplex automatic brakes, which are both a safeguard against the accidental dropping of the load and against racing. They are entirely automatic. One is a mechanical brake applied continuously by the reaction of the load itself, and released by the pull of the motor. The other is applied by a powerful spring and acts continuously except when withdrawn by a solenoid in series with the hoisting motor. The mechanical brake prevents racing in lowering as the magnetic brake is then withdrawn by the current actuating the motor, both motor and load acting in the same direction. The magnetic brake enables the load to be promptly stopped. The two acting together give great accuracy of control.

The truck wheels are cast from charcoal iron, and the treads chilled deep and hard and ground true. The shafts and bearings are unusually long. All parts of the machine are within easy access.

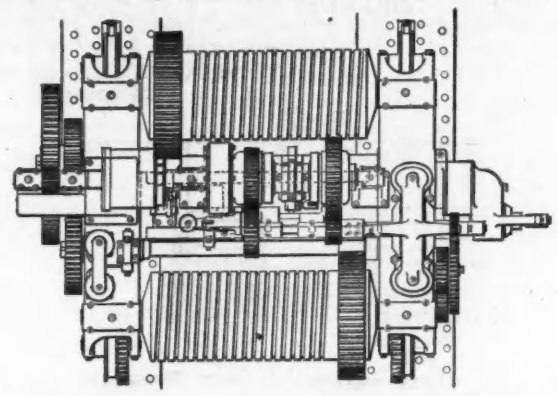


Fig. 2.—The Shaw Electric Traveling Crane.

These cranes are manufactured by the Shaw Electric Crane Company, of Muskegon, Mich. Manning, Maxwell & Moore, of New York and Chicago, are sole agents.

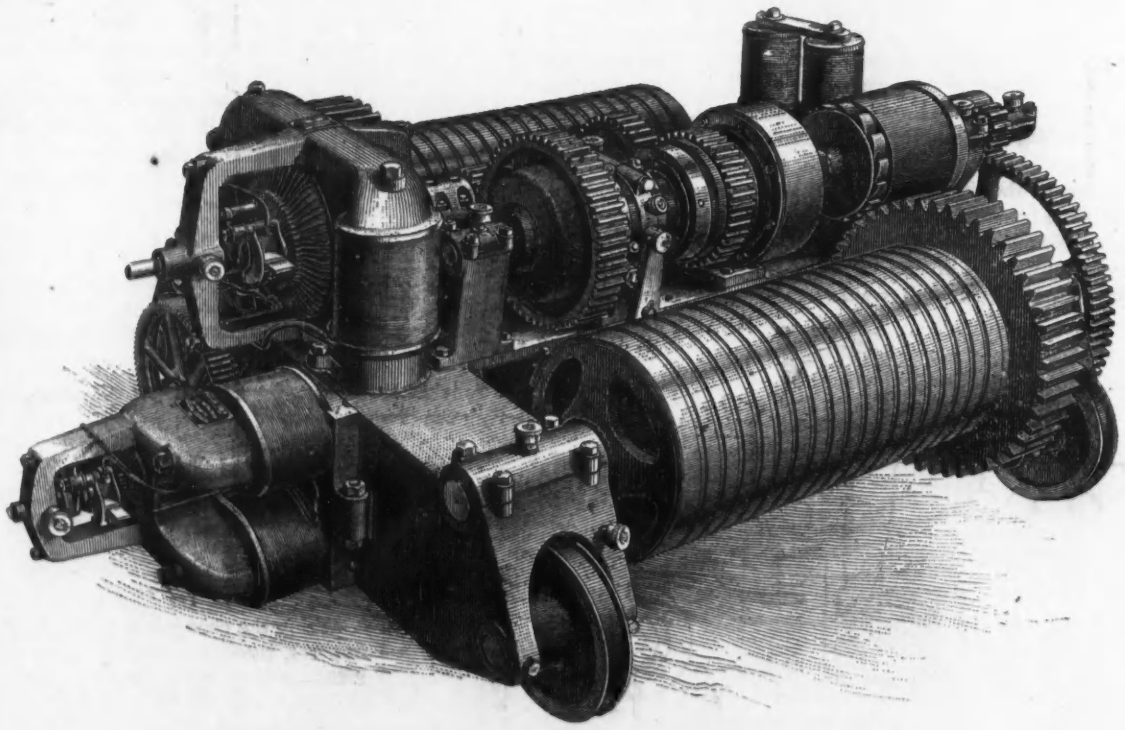


FIG. 1.—THE SHAW ELECTRIC TRAVELING CRANE.

Decorative Electric Lighting.

As the electric lamp comes more and more into use in house lighting many unique and striking features are developed. For decorative work it stands without a rival, and the possibilities in the field are without limit. The accompanying illustration, for which we are indebted to the New York *Tribune*, represents one of the exhibits at a recent electric light exhibition. A handsome bronze stork stood holding in its beak what appeared to be an immense pearl of remarkable brilliancy, but which in reality was, of course, an electric lamp. Several similar devices have been used as rather startling decorations for the dinner table.

Decorative Electric Lighting Fixture.

It is only a question of time when electric lighting will entirely supersede gas in the lighting of private residences. Many imaginary objections are prevalent at present concerning its use in domestic service, particularly as regards its safety. These objections will disappear as the public more generally become convinced that the progress of invention has demonstrated the possibility of appliances which can be effectually used to control the electric current.

The Practical Operation of the Gearless Motor.*

BY S. H. SHORT.

At first thought it does not seem necessary to place on the market a motor of new design which involves the abandonment of gear wheels for transmitting the power of the armature to the axle, but when we consider it carefully and examine all the advantages to be gained by so doing, we feel justified. If you recall the history of the steam locomotive you will remember that in the first machines the power was transmitted from engines through gear wheels to the axles. This was soon abandoned because of the wear on the gears, the noise, the breakage, and the many things which rendered it impracticable, especially where high speeds were required. If you will look back over the history of the electric street car motor, you will remember that among the first experiments which were made the high-speed armature was geared down through a long train of gears to the axle. Finally, within the last two years, the practical operation of electric motor cars with two sets of gears, of a double reduction, has become quite general. It has now been found, however, that these gears are a great source of expense in the operation of electric street cars, and it has been the object of the manufacturer to reduce the number of gears in street car practice as far as possible, until we now have all of the well known electrical manufacturers offering a motor for street car service with but a single reduction, and we have already found in practice that this is immensely superior to the old double reduction type o

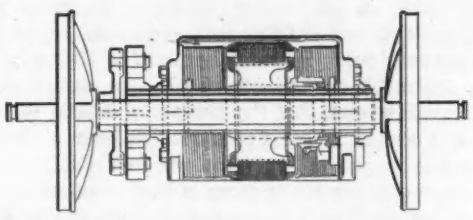


FIG. 3.—SECTIONAL VIEW OF GEARLESS MOTOR.

two years ago. While this single reduction type of motor is undoubtedly eminently successful, I believe we can go a step further with great advantage, that we can connect the armature directly to the axle of the car, without the intervention of armature, intermediate or other kind of gears. The abandonment of gears, or a "gearless" motor, is undoubtedly absolutely necessary where high speed is required for driving trains of cars upon suburban or interurban lines—a thing which we shall undoubtedly be called upon to do within the near future. It will be well for us to inquire into the disadvantages of the spur gear, which is the form which has finally been adopted as the only successful method of reducing the armature to the axle speed. These gear wheels vary in efficiency of transmission of power with the load and with the speed. They

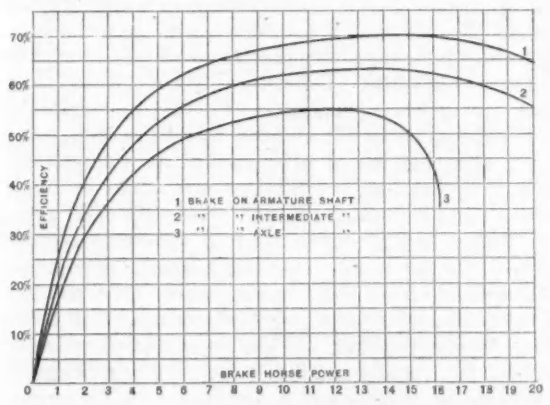


FIG. 1.—EFFICIENCY CURVES OF STREET CAR MOTORS.

wear rapidly, especially when placed under a street car in the dirt, grit and mud. This wear of the gears has been a very serious thing for the electric railways during the last three or four years. The repairs upon street car motors have been mostly because of the use of gears, and the cost of maintaining an electric motor car has been due large to this one thing. With the single reduction motor, of course much more than half of the difficulty has been removed, but we believe that with the gearless motor, which does not contain any of these wearing parts and without the armature and intermediate bearings and shafts, bolts and nuts, etc., we can get rid of all this source of cost in operating electric street cars.

Those of you who have operated electric street car lines can appreciate what a serious thing it is for a tooth to break out of a gear in a car motor while it is in service. The car is loaded with passengers who have paid their fares. If one tooth breaks, the probability is that more will follow; finally the teeth of the gear do not mesh with the pinion, and it either bends the armature shaft or breaks the motor frame. Probably the wheels become locked and the car is unable to proceed on its journey. The passengers must be removed, and the car must be taken from the track or dragged to the car house by another motor. This is calculated to make the patrons of the road dissatisfied with the electrical system, and it creates a feeling of distrust in the public mind about the certainty

* A paper read before the Chicago Electric Club.

and regularity of the operation of the cars. Nothing could be more serious for a street railway management than a feeling of distrust among the patrons of the road. While this is not now as common an occurrence as it was a year ago, because of the fewer gears in the single reduction motor and the fact that we are making our gears of steel, which lasts longer and breaks less frequently, still the trouble is serious.

Again, it is a great source of loss to a street railway

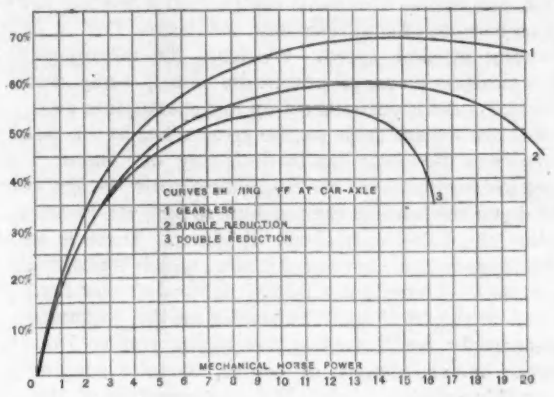


FIG. 2.—EFFICIENCY CURVES OF STREET CAR MOTORS.

company when it is necessary to take a car out of service to replace worn out gear wheels. A car earns on an average in a good street car city, about $20 per day. If the car is taken off of the road for half a day or a day, we not only lose the cost of the repairs, but we lose the profits on the day's run.

The causes which disable cars should be reduced to the minimum, and it is to this end that we are advocating the use of no gears in a street car motor. It is very seldom now that we have trouble with armature bobbins and field magnet spools burning out. While we had some difficulty of this kind in the early days, we have learned how to insulate and protect the motors for street car service, so that electrically they are quite equal to the work they are required to do. We have therefore to look more carefully to the mechanical construction of a street car motor and perfect that part of the machine. We believe that we should make a street motor with as few parts as possible and especially should we endeavor to do away with the wearing parts.

If we can abandon the gears you can easily understand that we not only do away with them, but also with those wearing parts which accompany a train of gears—fast running shafts and their bearings, box caps, nuts and bolts—all of which need looking after.

We will now take up the matter of the power lost in spur gearing, and see what we can gain in that direction by abandoning gears. When we first took up the subject of a gearless motor, we set about to see how much could be gained in the efficiency of transmission of power by doing away with the gears. I made a very careful and thorough investigation of the losses between the armature pinion and the intermediate gear, and between the intermediate pinion and the axle gear, of a double reduction motor. I first put a double reduction motor in good order, eliminating the armature bearing losses as much as possible, by running the motor for a long time, to wear the bearings down to a good surface. I put my power brake for determining the horse power directly on the armature shaft and ran my motor, delivering different horse powers all the way from no horse power to its full out-put—20 h. p. At the same time we measured the electrical horse power which was being put into the motor, and from this we constructed a curve of efficiency of the motor at different loads, which curve is reproduced as the upper curve in Fig. 1. The greatest efficiency reached by this motor was about 70 per cent. at a load of from 14 to 16 h. p. The efficiency at small loads, say at 2 h. p., was something like 50 per cent., at 4 or 5 h. p. an efficiency of 65 to 70 per cent.

We then took the brake from the armature shaft and replaced it with a well made armature pinion, allowing it to mesh with a well made intermediate gear, these gears being

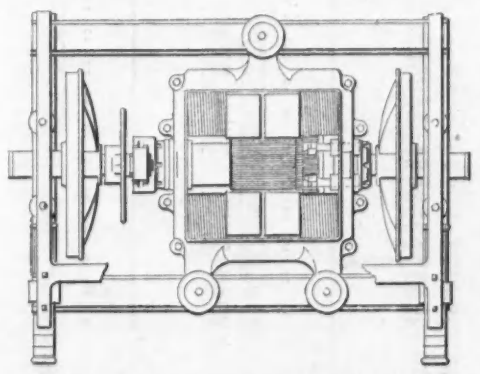


FIG. 5.—PLAN OF GEARLESS MOTOR.

cut as nicely and as carefully as possible, so that there would be the least possible loss between the two in making this test. Putting the brake on the other end of the intermediate shaft we again secured the number of readings of the horse power delivered, after being passed through this one pair of gears, the electrical horse power being indicated carefully at the same time. From the efficiency at different horse powers thus obtained we produced a second curve, which is shown in Fig. 1 as the middle curve on the diagram, and we find that the efficiency of this arrangement has fallen considerably. We once more removed the brake and placed the intermediate pinion on the intermediate shaft, allowing it to mesh with the axle gear. The brake was now placed on the axle itself, and another set of measurements—the same as those before made—were secured, and a curve of efficiency again plotted, which showed a large loss in these gears, the efficiency at the axle being less than that at the armature by an amount indicated by the two outer curves. The results showed that at 14 h. p. delivered by the motor we obtained an efficiency of 70 per cent. as a maximum when the brake was placed on the armature shaft. When the brake was placed on the intermediate shaft delivering 14 h. p. the efficiency dropped to about 62 per cent. When placed on the axle, the efficiency dropped to a little less than 55 per cent., showing a loss in the gears of some 15 per cent., when delivering 14 h. p. You will find in going over these curves that the loads vary considerably with the speed. Making an efficiency curve of the gears alone at different speeds, you will find the efficiency is very low at heavy loads and slow speeds and rises to its highest at medium speeds and medium loads. It again falls when running up to higher speeds. For this reason it is more economical to run a geared motor not too fast or too slow, but at a medium speed. This fact has been established long since in the use of gears in other classes of machinery, and in designing machines where

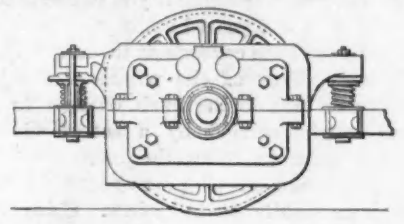


FIG. 4.—END ELEVATION OF GEARLESS MOTOR.

power must be transmitted through gears the best possible speed at which gears are to be run and the relation between pinion and gear are carefully considered. In the single reduction motor we regain, we might say, more than half of this loss in efficiency, because the gears are run at a moderate speed. I think that this one feature of gear loss makes it desirable to abandon their use in street car motors if possible. If we can save in practice 15 or more nearly 20 per cent. of the power consumed in operating a street car motor, by using the gearless instead of the double reduction type, it is well worth while, as this means the consumption of less coal and the reduction of first cost in the power plant and accessories.

Fig. 2 represents another set of curves developed in the same way as those shown in Fig. 1. Three motors were used

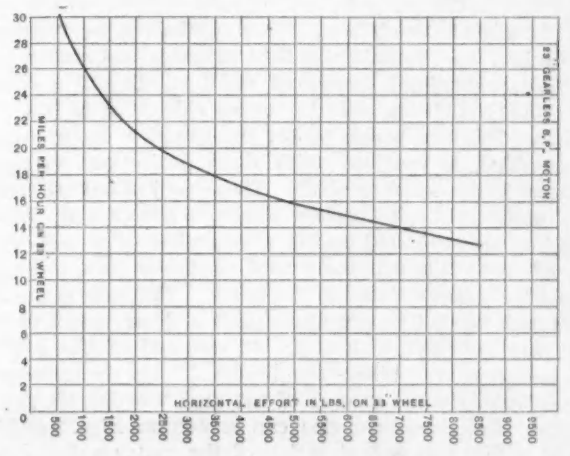


FIG. 6.—CURVE SHOWING HORIZONTAL PULL OF 20-H. P. GEARLESS MOTOR.

in this test—the double reduction, single reduction and the gearless. In each case the power brake was placed on the car axle. The double reduction motor curve, showing the efficiency at different horse powers, is practically the same as the lowest curve in Fig. 1. The power brake placed on the axle of the single reduction motor shows the loss in but one pair of gears and its axle efficiency is greater than that of the double reduction. In the gearless motor, however, there is no loss between the armature and the axle, therefore the curve shows the actual efficiency of the motor itself. In the single reduction motor the relation between the diameter of the pinion and the gear is greater than it is in the double reduction, therefore the loss is somewhat greater. If we had a still slower running motor armature on the single reduction, so that the pinion could be larger and the gear smaller, this loss would not be so great, and the efficiency at the axle would be greater. From these curves it is seen that the efficiency of the gearless motor at the axle, when delivering 14 h. p., reached very nearly 70 per cent., or very nearly the same efficiency as the double reduction motor at the armature shaft. The single reduction motor, when delivering the same power through one pair of gears, showed an efficiency of 60 per cent., while the double reduction shows a little over 50 per cent. These practical tests show that with the gearless motor we actually save from 15 to 20 per cent. in the power it is necessary to put into the car in order to get the same result at the axle.

We will now give you a description of the construction

of our gearless motor. Gearless motors have heretofore, as you well know, been constructed and operated. The armature has been placed directly on the axle and fairly good results have been obtained. The City and South London Railway in London is operating its road with gearless motors to-day. These motors are high speed, making the problem somewhat easier. It is, however, difficult to construct a small motor, not too large to be placed under an ordinary street car, the speed of which shall not be above 105 to 150 revolutions per minute. Because of the light construction of the road-bed in street railways it is also necessary to avoid the heavy hammer blow which occurs at the rail joints from a motor partly or entirely carried on the axle. When the wheel of the car passes from one rail to another it falls, striking a very heavy blow. If we have a weight directly attached and carried on the axle, without any intervening cushion or spring, we will have a very severe sledge-hammer blow on the rail at every joint. This will soon pound out and destroy the rails.

You are all familiar with the difficulty which is experienced in keeping up the rail joints on an electric line. The reason for this is apparent, if we think a moment, as it is a new element which has made its appearance since the introduction of the electric motor. All geared motors are supported at one end directly on the axle, by means of axle bearings. At the other end these motors are supported on springs; thus one-half the weight of a geared motor is carried directly to the car axle without the intervention of any flexible material. Imagine if you please that we could cushion both ends of a geared motor and put a spring between the motor and the car axle at the axle end. We will relieve the heavy blow of the wheels at the joints, and the wheels would not do as much damage to the track The actual weight carried by a set of wheels on the rails does not seem to affect the joints materially. Old horse cars, even when carrying heavy loads of passengers, did not affect materially the rail joints. Cable cars do not destroy their tracks, no matter how great their loads. Therefore it must be that this heavy weight of the motor carried solidly on the axle is the thing that is breaking down the rail joints on electric lines.

This heavy jarring also crystallizes the axles, and we have complaints from all over the country that axles on motor cars are breaking. When we come to examine these breaks we find that the iron has crystallized, and the manufacturers are now endeavoring to overcome this by increasing the size of the axles. With the gearless motor, as we now construct it, none of the weight is directly carried on the axle. By referring to Fig. 3, which shows a section through the axle of the gearless motor, it will be seen that the armature is mounted on a hollow shaft which surrounds the axle, leaving an air space of about an inch entirely around the axle. This hollow shaft is really the armature shaft of the motor, and is carried in its own independent bearings in the motor frame. The motor frame consists of a box made in two halves. These two halves are fastened together, and contain the field magnets and enclose the whole, protecting it from mud and dust, the only opening in the box being on the upper side next to the car floor. This box, which makes the complete motor when assembled, is provided with three projections at right angles to the armature shaft. These projections are made to receive steel spiral springs, similar to car springs. These springs are supported on the cross girders of an ordinary truck, such as is commonly used for motor cars, and support the entire weight of the motor. The axle is passed through this hollow armature shaft and can move freely in any direction within it. At one end of the hollow armature shaft is placed the flexible driving device which communicates the motion of the armature directly to the axle. This driving device can be seen in Figs. 3 and 5; and in Fig. 4 an end elevation of the motor is shown together with the spring mounting of the motor and a section of the axle in the centre of the hollow shaft. Fig. 5 shows a plan of the motor as you would look down through the trap doors in the floor of the car, the field magnets and armature, commutator and brushes all being revealed, and the ease with which you can get at the brushes and all the various parts of the motor is well shown. The axle also has a free end play of 2 inches through the motor and armature shaft. This is necessary in rounding curves and to insure freedom for the movements of the truck.

When the wheels drop from the end of one rail to another the motor does not immediately follow, its inertia being so great. The wheels not being very heavy do not make a heavy blow, but by the time they have reached another portion of the rail the motor falls down against its springs, distributing, as it were, the blow over a considerable length of the rail, thereby preventing serious damage to the rail joint.

The question is often asked: "How do you obtain the necessary power or tendency to turn the wheels around, without using an abnormal amount of current in so doing?" It is contended that in a geared motor we have an enormous leverage through the gears. If we had a small armature, the same as is used in the geared motors on the axle, we would not, of course, be able to start the car, or to do the work necessary in moving a loaded car, but we have a large armature placed in a very strong magnetic field, and we have a great many more turns of the same current around the armature, thereby gaining in two ways a greater leverage, because of a larger diameter of armature and a greater pull at the end of that lever, and because of the increased number of turns of wire on the armature and the stronger magnetic field. It is something analogous to the steam engine. If we replace an electric motor with a steam engine, we can use a small engine under the car with a small cylinder and run it at high speed and gear down to the car axle, or we can use a large engine connected directly to the axle, as is common now in locomotive practice, and run it slower and get the same power, with, as has been demonstrated in steam motors, greater economy. You can make a similar comparison between the high speed engines of small size and the larger Corliss engines running at slow speed. We have the advantage in the slow running motor of practically doing away with the loss in Foucault currents set up in the armature ring. Air resistance we are liable to, the greater loss in the dead resistance of the motor, but by designing our motor with a very low resistance of the magnetic circuit we are able to cut down the wire on the machine so that its resistance is quite low, being only about 2½ ohms. There is another advantage in this slow speed motor, which is not small; the wear on the commutator is very light, and the heat produced by the friction of the brushes on the commutator is exceedingly small, making the motor run cool in all its parts. We are obliged, of course, to take advantage of everything that is possible in the construction of the gearless motor, in order to make it small and light enough for street car service. We use the best wrought iron and steel in its construction, because of their superior magnetic qualities. We have to use the best copper of highest conductivity to reduce our resistance losses. This, of course, is in the end an advantage to the machine, because it makes it stronger and less liable to breakage.

It has been urged by some that the gearless motor is more difficult to repair than a reduction motor, and that it is a serious thing to repair an armature bobbin which has been burned out, because the armature will have to be taken out of the machine and the wheels pulled off, in order to get at it. By referring to the drawings of the gearless motor it is easy to see that by dropping the lower half of the casing into the pit it leaves the upper half of the motor carried on the truck frame, and by simply raising the car body the armature can be rolled out from under the car without taking it off the axle or removing the wheels. In practice we should have one of these axles and wheels, with the armature already attached, to roll back into the place of the damaged armature. Replace the lower casing of the machine, and the car can be put immediately into service, and the damaged armature bobbin rewound in its place on the axle, there being no need of ever removing the wheels from the axle, except when the wheels are worn out and have to be replaced with new ones. The gearless motor armature can be removed from the car by one man in as short a space of time as the geared motor armature can be removed, and without so much danger to the armature, as it is well protected from abrasion and injury in handling.

To answer the question as to how much current is taken by the gearless motor in operating a car, we have prepared a copy of readings taken from a car in actual service, drawing a trail car. The current readings, also the pressure readings, were taken every half minute, and from the table a very good idea of the amount of current required can be gained. These readings were taken in August on the East Cleveland Railroad, Cleveland, O. On this road the traffic is very heavy, although the grades are light, but by comparing these results with those obtained from single and double reduction you will find that there is practically little or no difference between the current readings. The average readings, however, in the test run with the gearless motor will be considerably lower than those with the geared motor, owing to the fact that we have got rid of the gear friction. The gearless motor will coast so easily that on a very slight down grade a car equipped with the gearless motor will run up to speed without any current being used, and in making stops the current is shut off from a gearless car long before it is in a geared motor car. These intervals of the use of little or no current, as compared with the intervals in which there is little or no current used in a geared motor, are very considerable, and represent the extra loss in the gears.

GEARLESS MOTOR TRIAL—AUG. 17, 1891—IN REGULAR SERVICE PULLING TRAIL CAR—TEMPERATURE EQUALS 96 DEGREES F.

Time.	Car.	Volts.	Remarks.	Time.	Car.	Volts.	Remarks.	Time.	Car.	Volts.	Remarks.
2:20	33	448		2:46½	16	400		3:13	30	412	
	31	420		7	18	424			0	420	99 amp.
1	19	424			18	440		4	50	412	to st'rt
	0	428		8	27	428			0	436	
2	30	416			0	400		3:15	47	420	
	55	400		9	23	400			64	416	
3	19	424			0	420		6	21	420	
	17	436		2:50	51	400	Start		19	420	
3	..	....			20	380	@96° a.	7	16	420	
	..	....		1	60	360			16	436	
2:25	16	440			33	396		8	14	420	
	0	460		2	0	400			14	420	
6	0	440			60	404	Start.	9	15	420	
	16	448		3	20	420			16	424	
7	21	448			0	480		3:20	30	436	
	17	444		4	0	360			0	440	
8	15	424			19	416		1	35	440	
	15	424		2:55	59	334			27	428	
9	0	420			44	436		2	25	420	
	0	444		6	50	380			0	420	
2:30	18	436			0	400		3	56	448	
	19	436		7	0	0			0	460	
1	31	440			20	360		4	41	440	
	28	440		8	0	360			30	460	
2	14	440			70	320		3:25	27	448	
	0	440		9	17	400			22	440	
3	18	448		..	....			6	27	444	
	19	460		3:00	..	....			24	460	
4	17	456		..	....			7	15	440	
	17	460		1	27	368			14	448	
2:35	0	460			27	380		8	22	440	
	20	460		2	0	380			27	440	
6	70	460	Start.		21	404		9	16	460	
	32	456		3	0	380			0	460	
7	24	460			59	360		3:30	0	456	
	40	416		4	41	356			0	440	
8	57	400			20	380		1	18	420	
	26	436		3:05	45	396			39	430	
9	77	420	Start.		54	360		2	40	420	
	85	420		6	0	426			16	430	
2:40	0	440			72	408		3	17	424	
	37	420		7	31	380			25	420	
1	16	448			20	396		4	27	440	
	15	440		8	0	420	70 amp.		16	420	
2	24	420			55	400	to sta't.	3:35	68	420	Start.
	14	424		9	15	408			40	440	
3	16	424			20	408		6	40	416	
	55	420	Start.	3:10	38	400	80 amp.		35	420	
4	20	440			41	396	to st'rt.	7	15	400	
	0	420		1	55	400			16	416	
2:45	0	420			31	420		8	31	420	
	0	436		2	27	408			35	412	
6	31	430			70	380		9	0	440	

We have carefully tested double reduction, single reduction and gearless cars running on the same track, on roads in Cleveland, O., taking at the same time readings of current and pressure, and we have found that in some cases the single reduction would require the least amount of current, sometimes the double reduction and sometimes the gearless, depending upon the number of passengers hauled, stops made, and other things that might come in to consume more or less power; so it is difficult for us to say that there is any difference in actual power consumption between the three classes of machines. The gearless motor is capable of starting loads as quickly as the geared motor, and is capable of starting as heavy a load under similar conditions, and we have a curve shown in Fig. 6, which illustrates the actual horizontal pull of a 20-h. p. gearless motor, mounted on 33-inch wheels. In examining this curve it will be seen that the horizontal effort in pounds when the car is running 20 miles per hour is about 250. In ordinary street car practice we find that it requires about 20 pounds per ton to move a load on street car rails. This means that with a horizontal pull of 250 pounds this single motor could move a car weighing 12 tons at the rate of 20 miles per hour, or, as the curve will show, that at 14 miles per hour the motor has a horizontal pull of 700 pounds, or it will move a load of 35 tons at the rate of 14 miles per hour on a level track. This curve is not falling off rapidly, certainly not as rapidly as it would with a geared motor, because the loss in the gears begins to increase very rapidly with the heavy loads. You can easily figure from this curve what the motor will do under any conditions of load, grade and speed. The tendency in street car practice is to increase the speed of the cars, and the gearless motor lends itself especially to this end, as we have found that with very rapid speed geared motors wear out the running parts more rapidly, and become very much more expensive to maintain. While the gearless motor can operate with as great economy at the slow pace required in crowded streets it is also capable of running at a very much higher speed in suburban traffic without the slightest fear of damage to the machine. In this respect it makes a very much more flexible motor than the geared machines. You can easily understand that this motor now makes it possible for us to develop large electric locomotives to be used in elevated railway service, and for pulling suburban trains in and out of large cities. From calculations and designs which we have made, we find that the size and weight of the motors required for 200 and 400 h. p. locomotives is not more than is necessary to produce the required adhesion to the rails needed for the required tractive pull to move these heavy trains. The motors are not large comparatively, and their economy will be very great. We believe that this branch of electric railroading will develop rapidly and that within a few years gearless electric railway motors will be used in places, for purposes, and in numbers unthought of at the present time.

The discussion which followed was largely of a cross-questioning nature, a number of those present taking turns at asking Mr. Short questions concerning the comparative efficiency under various conditions, as he had found them in practice, of the single-reduction and gearless motors. Mr. Grier inquired in what distance a speed of 20 miles an hour could be attained from a dead standstill. He considered this to be the vital question in the use of electric motors on elevated roads, as in this service a maximum speed must be attained in about 200 feet. Mr. Short replied that the distance necessary depended on the power of the motor, and that in order to compete with the steam locomotive in this respect it was only necessary to build a motor of large enough capacity. The motor could be started and reach maximum speed as quickly as a steam locomotive, provided it was large enough to prevent its being overworked. Mr. Short referred to the experiments made on the New York elevated roads, and said that the failure of the electric motors at that time was entirely due to the fact that they were not large enough to pull the trains in actual service. As a matter of fact, electric locomotives could be made which would get up the maximum speed in a shorter time with a given load than steam locomotives now do.

Mr. Short referred to the fact that in the application of the gearless motor to the axle of the locomotive an important feature to be noticed was the constant pull throughout the whole revolution of the driving wheels as compared with the less efficiency of the unequal pull obtained in starting the

steam locomotive. It was for this reason that Mr. Short believed an electric motor could start a train quicker than a steam motor.

In regard to the question of conductors for transmitting the current to the motors when used for elevated road service, Mr. Short said that the question had not been settled, but it seemed to him that a very convenient place would be just above the ties, say six or eight inches. Objections to this, of course, he said would occur to any one in such places as the cross-overs and on road crossings where trouble might arise with the conductor, and it might be possible that trackmen would be liable to get shocks at such places. However, he said that on an elevated road system there would be no objection to the use of an overhead trolley wire, using the rails for the return. In such a case, however, it would be necessary to provide special means for taking the current from the wire because of the insufficient contact that would be obtained by the use of a single trolley wheel.

Discussing the question of a practical braking system, Mr. Short said that if he were equipping a train he would use the ordinary Westinghouse air brakes now used on railways. The air would be pumped by a separate motor on the locomotive, a method which to him seemed a feasible and practical one.

Mr. Jackson called attention to the fact that there are two kinds of street railway service to be taken into consideration in deciding upon motors for this class of service. The first question that arises is what sort of traffic is to be carried, and, second, how can this traffic be carried most economically and at the same time so as to attract the largest number of passengers out of the possible traffic. Dividing the service into short haul and long haul classes, Mr. Jackson called attention to the fact that in order to secure any large amount of the short haul traffic it was necessary to make access to the cars as easy as possible. For this reason he considered it a mistake to place 30 or 33 inch wheels under the cars, and he thought it would be much better to use 26-inch wheels instead. Of course if this kind were used he would use the single reduction motor. On long distance or suburban traffic, however, he was in favor of using 33 or 36-inch wheels, giving an opportunity for the use of the gearless motor under the best conditions for securing great efficiency. This he considered to be the proper field for the gearless motor.

Annual Report of the Thomson-Houston Electric Company.

The annual meeting of this company was held at Middletown, Conn., on Monday of this week. The old board of directors was re-elected and the report of the company's finances and business for the year ending Feb. 1, 1892, was presented by Vice-President Coffin.

The following board of directors was elected: H. A. Pevear, C. A. Coffin, J. I. Smith, B. S. Spinney, C. H. Newhall, S. A. Barton, E. Griffin, S. E. Peabody and T. J. Coolidge, all of Boston.

The report contains many interesting figures regarding the business of the past year. Owing to the extremely depressed and precarious condition of the commercial interests of the country at the opening of the year an essential decrease in the business of the company was experienced during the first few months of the year, particularly in that portion derived from the local lighting organizations operating from central stations. The business of the street railway department was seriously interfered with during the spring and the early summer by a radical change in the type of motors manufactured by the company. This loss, however, was wholly recovered during the second half of the year.

The unfilled orders in hand at the present time, as compared with the same date of the last year, are more than double in amount; and in each of the various departments of the business, the orders received since the first of January are very largely in excess of those of a year ago.

A recapitulation of the business from the Boston office of the company for the past nine years is as follows:

1883	$426,987.97	1888	$4,435,902.23
1884	700,470 46	1889	8,222,789.12
1885	983,996.05	1890	10,217,661.67
1886	1,405,041.74	1891	10,304,780.17
1887	2,385,594.80		

As stated above, the activity in local company enterprises has been less than during the previous year. Notwithstanding this, the newly-organized lighting companies established during the 12 months ending Jan. 1, 1892,

Aggregated in number	118
The total number reported Jan. 1, 1891, was	755
Total Jan. 1892	873

These companies have in use 100,293 arc lights and about 800,000 incandescent lights manufactured by the Thomson-Houston Electric Company, as compared with 87,131 arc lights and 616,355 incandescent lights Jan. 1, 1891.

The number of street railway companies operating and under contract, reported Jan. 1, 1891, was 145; added during the year, 59; total, Jan. 1, 1892, 204. Employing altogether nearly 3,000 cars, with an aggregate mileage of about 2,500 miles.

The balance sheet as presented by Benj. F. Peach, Jr., assistant treasurer of the company is as follows:

THOMSON-HOUSTON ELECTRIC COMPANY.
Balance Sheet, Jan. 30, 1892.

ASSETS.

Accounts Receivable, Mdse	$6,601,293.03	
Less deductions, 10 per cent. (a)	660,129.30	$5,941,163.73
Notes Receivable	1,636,800.35	
Less deductions, 7½ per cent. (b)	122,760.03	1,514,040.3
Cash		1,727,276.16
Real Estate, about 70 per cent. of cost		430,241.24
Machinery and tools about 60 per cent. of cost		491,044.53
Office furniture and fixtures (c)		
Cost $27,334.23 (ch'gd off)		135,000.00
Paterns and Models		338,354.29
Patents (Expense for the year charged off.		
Local Company's stocks, 35 per cent of par (e)		473,586.60
Local Company's bonds, 70 per cent. of par (f)		1,858,570.00
Manufacturing Company's stock, at cost (g)		3,729,195.50
Construction Company's stock at cost (g)		1,210,750.00
United Securities Company's stock at cost		525,420.00
Consignments		32,116.79
Merchandise inventory, factory (h)		1,731,481.55
Merchandise inventory, railway supply department		72,593.23
Merchandise inventory, lighting supply department		52,613.63
		$20,263,447.57

LIABILITIES.

Capital Stock—Common		$6,000,000.00
Capital Stock—Preferred		4,000,000.00
Accounts Payable—Merchandise		498,808.24
Notes Payable—Collateral		1,429,486.14
Notes Payable—Unsecured		587,005.23
Mortgage		1,200.00
Guarantee Account (from accrued surplus)		200,000.00
Surplus Feb. 1, 1891		6,022,533.71
Profits for the year	$2,760,780.25	
Less dividend paid during the year	1,236,366.00	1,524,414.25
		$20,263,447.57

STATEMENT OF SURPLUS ACCOUNT.

Surplus Feb. 1, 1891	$6,022,533.71	
Income for year ending Jan 30, 1892, after deducting dividends paid during the year	1,524,414.25	
Surplus Jan. 30, 1892		$7,546,947.96

In explanation of the deductions made from the assets of the company, it may be stated that following the conservative policy that has always prevailed, allowances have been made with an idea of placing upon each and every asset a value which will be safe in any contingency.

(a) From accounts receivable the same deduction has been made as in former years. This has, in previous years, always been found ample.

(b) The deduction of seven and one-half per cent. from Notes Receivable is two and one-half per cent, in excess of the rate deducted in former years, and is regarded more than a sufficient guarantee for contingencies.

(c) Following the precedent of last year, the expense incurred for office furniture and fixtures during the year has been charged to expense account.

(d) While a large sum has been expended during the past year in the acquisition of patents, this has all been charged to current expense instead of adding to the patent account.

(e) In local company's stocks a deduction of 65 per cent. is made, which is five per cent. in excess of deductions in former years. More than $200,000 of stocks and bonds of railway and lighting companies at par value are carried in a separate account as of doubtful, though of considerable prospective value, and do not appear in the inventory at all.

(f) These bonds are nearly all payable in gold, and are amply secured by sinking funds and other protective provisions, made under the supervision of competent attorneys of our own selection. A large profit should be realized from the sale of these bonds.

(g) The Manufacturing and Construction Companies' stocks are taken at their cost value. The companies represented by these stocks are making very satisfactory earnings and working in harmony with the Thomson-Houston Company, thereby contributing largely to the success of this company.

(h) The inventory of merchandise and material at the factory has been taken in the usual way, *at less than actual cost.*

The following table shows the number and capacity of the companies using arc and incandescent lights of the Thomson-Houston system in the United States:

	No of Companies.	No. of Arc Lamps.	No. of Inc. Lamps.
Jan. 1, 1883	5	365	...
Jan. 1, 1884	31	2,478	....
Jan. 1, 1885	59	5,867	....
Jan. 1, 1886	100	13,227	....
Jan. 1, 1887	171	21,840	11,275
Jan. 1, 1888	303	36,936	59,330
Jan. 1, 1889	419	51,621	120,380
Jan. 1, 1890	587	68,203	281,555
Jan. 1, 1891	755	87,131	616,355
Jan. 1, 1892	873	100,293	806,500

The following table shows the number of railway companies using the Thomson-Houston system:

	No. of companies.	No. of cars.	Miles of track.
Jan. 1, 1890	92	701	420.29
Jan. 1, 1891	145	1,532	1,159.81
Jan. 1, 1892	204	2,769	2,363.63

The statement of profits and surplus account makes the following showing:

	Added to Surplus from Profits.	Total Surplus.
Jan. 1, 1883	$17,237.85	.....
Jan. 1, 1884	93,696.74	$110,934.59
Jan. 1, 1885	96,187.10	207,111.69
Jan. 1, 1886	106,687.50	313,809.19
Jan. 1, 1887	123,006.05	426,815.23
Feb. 1. 1888	313,596.67	750,411.91
Feb. 1, 1889	660,828.82	1,411,240.73
Feb. 1, 1890	1,309,175.19	1,685,515.62
Feb. 2, 1891	4,337,117.79	6,022,533.71
Feb. 1, 1892	1,524,414.25	7,546,947.96

This addition to the surplus account for the year ending Jan. 30, 1892, amounting to $1,524,414.25, is the amount of profits after paying 7 per cent. dividend on the preferred stock and quarterly dividends at the rate of 16 per cent. per annum on the common stock.

Modern Views Respecting the Action of Forces and the Conception of the Ether.*

BY WM. STANLEY, JR.

As we look back over the history of mankind and scrutinize the thoughts of the foremost men of each age, we find that from the earliest dawn of intelligence down to the present day men have speculated on the possible causes of the existence of the world about them. Until a few years ago, until almost within the memory of living men, our race, with few exceptions, has accepted the doctrine of creation as the necessary and satisfactory basis, or explanation, of our existence, the existence of the organized world, and by inference has assumed that the processes of nature being of divine origin were beyond human conception. Within the last two centuries scientific investigation has discovered a great number of natural laws, which after careful study, having been classified and selected, are now the recognized standards of the performance of nature, under given conditions, and form a new basis for speculation on matters concerning which experimental data are unattainable with our present knowledge.

As these natural laws are studied, we find that they show that, under like conditions of cause, the same result is always attained in the same way, or, briefly, they describe the operation of forces in producing results discernible by our intelligence. We are all familiar with the manifestations of force, the various forms of energy, while we have no language with which to make force intelligible to our minds. We speak of electric force, thermic force, gravitational force, mental force, and we mean the ability to perform electric work, the ability to increase or decrease thermic energy, the ability (for reasons still unknown) possessed by bodies of attracting each other, the ability to perform mental operations. We are accustomed to think of these forces as resident in matter, depending upon its physical condition and structure.

The subject I wish to call to your attention to-night refers to some of the modern views respecting the methods by which these forces act to accomplish the results we are familiar with, and I shall endeavor to outline in a very popular and elementary manner the conceptions of the medium in which they act, known as the ether.

First, as to the medium; it is very desirable to ascertain if the various forces of nature act to convey each their particular form of energy in the same, or in independent mediums. Is there one medium by which every form of energy is carried, or does each form of energy use an independent path by which to travel?

As in every broad question of this character, experimental evidence at first appears contradictory, for we find that some *substances* convey heat and electricity, some light, and that no two *substances* offer paths of equal freedom to the translation of all forms of energy. For example: if we look at the filament of an incandescent lamp, we see that light emerges from, or is radiated by it in every direction: some medium is conveying light from the filament across the empty space enclosed by the globe, through the glass, across the air to the eye. Whatever the medium may be, it must exist in the vacuous space enclosed by the globe, in the glass, in the air, in the eye, and in fact, *in the brain:* in short, we see that the medium conveying light must exist in the same space as ordinary matter, and must exist in space unoccupied by matter. Suppose now we hold an opaque object, such as a sheet of hard rubber, between a luminous body and ourselves, we find that the light conveying medium has, so to speak, stopped, or its ability to carry light has been destroyed by the rubber, as no light can reach beyond this boundary line.

We know that a lamp emits heat as well as light; this heat is found on and outside of the glass, and being radiated across space beyond the bulb to great distances, may be made perceptible by proper instruments. If now we insert a screen of hard rubber between the source of heat and ourselves, and test the decrease of heat caused by the insertion of the screen, we find but little diminution of its power. We learn from these experiments that while hard rubber has the power of stopping the radiation of light, it does not equally stop that of heat, or that while it interferes with the conveying power of a medium which passes along light waves through air or glass, it does not in like manner necessarily interfere with the conveying power of the medium transferring heat.

We might, therefore, imagine that each force, as light, heat, or electricity, was conveyed by a separate medium operative when occluded in certain substances and inoperative in others, or that the various forces possessed some difference requiring specific conditions of universal medium to accommodate their transmission. One of the modern theories of the subject is the outgrowth of a very old conception.

According to this theory, the universe throughout the entire extent is filled full of a something which is called the ether, and which forms the highway over which all energy in whatever form, whether as heat, light, electricity, magnetic or chemical energy, is conveyed. We may imagine an infinite sea of this substance in which this and all other worlds are sunk or suspended; such a sea must be considered to be extremely strong or dense and infinitely elastic. If we conceive of such a medium or substance we can then form theories describing the methods by which energy is translated from one point to another that appear

*An address before the Boston Electric Club.

in accordance with our present knowledge. Of course, the first question such a proposition brings up is how do we move about in an extremely strong or dense substance? If a man were immersed in solid cast iron he, of course, could not move. To obviate this difficulty we might imagine the man to be bored full of holes in a certain direction, and imagine also that these holes were occupied by the ether, a very strong substance as iron, then, except for the difficulty of turning a corner, our unfortunate friend might travel about passing *through the iron*, while the iron remained stationary. To further help the assumption, we can assume the holes to be infinite in number and extremely small. I do not mean as small as the holes in a fine piece of muslin, nor as small as a molecule of which millions would be required to make the extreme point of a needle, but millions of billions of times smaller, so small, in fact, as not only to be forever indiscernible, but so small as to be undiscoverable by the man.

This gauze-like hypothetical substance then may exist everywhere undiscerned of itself, and may be endowed with all the properties, the assumption of which is necessary for the explanation of the propagation of forces from point to point.

A body or substance of a thing then actually moves through the ether, not between it; a bird flies through the air by parting it on either side, but passes from place to place in the ether without disturbing or parting it, the ether passing through this moving body as such body moves.

What basis have we for such a conception? Is there any evidence of such an ether, of an ether conveying all sorts of energy, so to speak?

We have seen—in short, we know—that the various forms of energy, light, heat, magnetism, etc., can go from point to point through a vacuum. Magnetism passes through vacua as easily as through air. It is well known that light, heat, electric and magnetic forces reach this earth from the sun. These forces have to pass through vast spaces void of matter. Evidently, then, any medium forming a common path for these energies must be independent of material substance, as we ordinarily understand the term. Now we have experimental data proving that the propagation of light, heat and electricity is the same: we have tested our ether, and have found that a light, heat, electric or magnetic impulse travels 186,000 miles per second through the ether in vacuo; if the transmission takes place through some *substance*—as, for instance, if a light wave be transmitted through a sheet of glass, the speed of transmission is reduced in some way we do not yet understand, and some of the energy of light disappears, taking on the form of energy we call heat. But if, as I have said, the transmission occur only in vacuo, the distance traversed per second by all the various forms of energy is the same, and this now well-established fact is taken as indicating the existence of but one universal medium.

I have said that our conception of the ether required a property of infinite elasticity. You know what elasticity is. We are familiar with more or less perfect elasticity in various substances, as rubber, ivory, glass, etc., but a perfectly elastic substance is a very different conception. Imagine a billiard ball possessing this property and a perfectly elastic block of glass; then, if such a ball could be dropped from any height upon the block in vacuo, it would rebound to exactly the height from which it fell, and it would continue to so rebound forever, the property of perfect elasticity always restoring to the ball the same energy of position originally given to it. Or conceive a tube of some perfectly elastic substance, say glass, reaching from this earth off through space indefinitely, then if one end of this tube were struck by a hammer the shock would cause a wave or compression to travel outward along its length, which, when once started on its journey, would continue forever; imagine the speed of travel of the wave to be 186,000 miles per second, and the simile may be thought to represent the travel or transmission of energy along a tube of ether, each impulse or wave being capable of delivering a certain amount of work dependent upon the force of the initial blow.

Let us for a moment consider the modern picture, conception, or theory, of how forces are transmitted in this assumed ether. Consider a tube of ether capped at each end with some substance; picture it as consisting of glass or some perfectly elastic substance; suppose one end of it to be in Boston and the other in New York. Call this tube an ether tube. Imagine some mechanical contrivance by which a hammer is made to strike the end of the tube in Boston with ever-increasing speed; thus let there be 100 blows on the tube during the first second, 200 blows during the next second, etc., etc.; the tube then will be expanded at the point of contact with the hammer, that is increased in diameter, by an amount depending upon the strength of the blow. As the tube is perfectly elastic, this local swelling or expansion of the tube started in Boston will travel to New York at the rate of 186,000 miles per second. Suppose at New York branch ether tubes are connected to the trunk line, let one such tube join it to a thermometer, another to a man's eye, and another to a bottle containing hydrogen or chlorine. Then as soon as the hammer is started in Boston, ether waves travel through the tube to New York, and traverse the various branch circuits, one of which leads to the thermometer. As they reach this instrument they will suffer a change, so to speak; we may think of them as being checked in some manner that causes them to deliver their strain energy as heat which will be registered by the thermometer, the same heat that would have appeared had the hammer struck the solid substance in New York. For some time after the starting of the hammer at Boston the eye connected by the branch ether tube will fail to record any sensation of light, and the gases in the bottle will not combine; but when the hammering at Boston becomes extremely rapid, when the number of blows at Boston exceeds four hundred and fifty billion per second, the eye at New York connected by the branch ether tube will discern a faint red light, which, continually increasing in strength and changing in color with the increasing number of blows at Boston, will successfully present to the eye all the colors of the spectrum. As the blows approached seven hundred and fifty trillion per second, the blue violet light visible to the eye would fade away into darkness never to be illumined again by the increasing frequency of the ether waves while the violent chemical combination will take place in the HCl bottle, caused by the combination of these elements in forming HCl.

A plant or leaf connected by another ether tube to the trunk line would also then decompose carbonic acid from the surrounding air and would build up its own structure. During all this time the thermometer first mentioned would continue to register an increasing temperature. As the frequency or number of blows per second is further increased, they would undoubtedly perform other work on organized matter, but we have no organs or powers by which to perceive such results. If now at any time during these experiments we have assumed, we could connect a voltmeter to the opposite sides of the trunk line, each passing wave sent from Boston would develop an E. M. F. between the opposite sides of the ether tube and would be indicated by the voltmeter; and again, if we could apply a magnetometer to two other sides of the tube at right angles to the voltmeter connection the magnetometer would indicate the presence of magnetism as each wave passed by. We see then that the modern theory of the transmission of energy is founded upon the assumption of a universal medium traversed by a wave-like disturbance. If this disturbance be a rapid succession of waves transmitted in a certain direction, so long as these waves do not exceed a certain number of 400 billions per second the entire energy appears to us as heat; if the frequency of these waves exceeds 400 and is less than 750 billions, they cause the phenomenon we know as light, while the phenomenon of electric strain takes place at right angles to such direction.

Can we then form some theory, described by some simile, that will explain how electricity is conveyed in a conductor? Let us consider what theory points out as happening when an alternate current generator urges a current over a line. We have assumed in our ether theory that all space and substance is full of ether. Imagine the ether within a copper wire to be somewhat different from the ether outside in the air, and suppose it to be subject to pressures or strains when connected to some mechanical device, and assume that an alternate generator is a device which when connected to the ether contained in a wire gives it a peculiar screw-like thrust, first in one and then in the opposite way as each successive E. M. F. is induced in the armature circuit. These ether thrusts then represent the E. M. F. waves of the generator. They cause the ether in the wire to be driven or compressed in the direction of the length of the wire, and this compression may be thought to represent a flow of current. I have said the ether thrusts of the generator were screw-like, that is, both rotary and forward. The thrust along the wire corresponding to the pressure or E. M. F. is the forward thrust; the rotary thrust tends to rotate the ether in the conductor about the axis or centre of the wire. Of course the ether in the wire is but a part of, and is directly connected to the ether throughout the rest of the universe. The rotary movement of the ether within the wire must therefore tend to rotate the ether about it. Now we know that the travel of an ether movement is at the rate of 186,000 miles per second, and consequently the ether 186,000 miles away from the wire will receive a rotary impulse or strain one second after the starting of the rotary impulse within the conductor. During this second the rotational effect has progressed through the space mentioned. The transmission of a current or the generation of an E. M. F. along a wire, then, radiates ether waves outward at right angles to the direction of current transmission, and we have seen that if we get enough of these waves we obtain light. If, therefore, we could make an alternator that would twist the ether within a wire 400 or 500 billion times per second, we should radiate light from the surface of the conductor in every direction, or, briefly, the wire would be luminous.

We may consider a dynamo, then, to be a sort of either hammer or shaker which sets up a very peculiar and complicated ether motion. When we produce light in a carbon filament we make use of the resistance property of that material, which property seems to consist in a sort of damping of the ether waves, transferring such ether motions into motions of the individual molecules of the filament. In fact whenever ether motions take place in *any* substance they set up vibrations of the molecules of that substance, which molecular disturbance is evident to us as heat. Thus some of the waves of the sunlight falling on the window pane are arrested and cause motions among the molecules of glass, which warm it, the glass being able to exercise a sort of selective power, stopping some ether waves and passing on others. All substances exert this power. Those substances which transmit or are transparent to very fast waves stop or are opaque to slow waves; thus glass is transparent to the short, quick waves of light, and opaque to the long, slow waves of heat, while hard rubber is transparent to the slow heat waves, which are of course entirely invisible, and opaque to the fast, quick, visible light waves.

Now, as I have said, our eyes are tuned to or respond to ether waves, which occur between 400 and 750 billion times per second. The eye of a cat is tuned to a somewhat lower range. We can imagine an animal whose eye would respond to a very low frequency, so low that the ether waves radiated by an alternate current circuit would excite vision. To such an eye a sheet of hard rubber would appear transparent, our lighting circuits would appear as lines of light, and each stroke of an engine, or each thump of a belt driving a dynamo would cause a flicker in the radiant beams shining from the wire. It is possible and highly probable that in the future we shall discern the means of producing a sufficient number of alternate currents per second to cause special apparatus through which they are made to pass to glow with waves of light generated without accompanying heat. The investigations of Mr. Tesla and the researches of many investigators make this result probable, and, when this time has come, light will be the cheapest force at command. I am aware of the difficulties attending the popular treatment of such a subject, and the impossibility of expressing clearly the half understood relations existing between the forces of nature, the ether, and matter. We regard the various forms of energy—heat, light, etc.—as conditions of the ether, the ether something which can be pushed or strained but not materially changed, and matter as something contained in the ether whose sole duty seems to be to cause a change in these ether motions, and consequently a local appearance of energy.

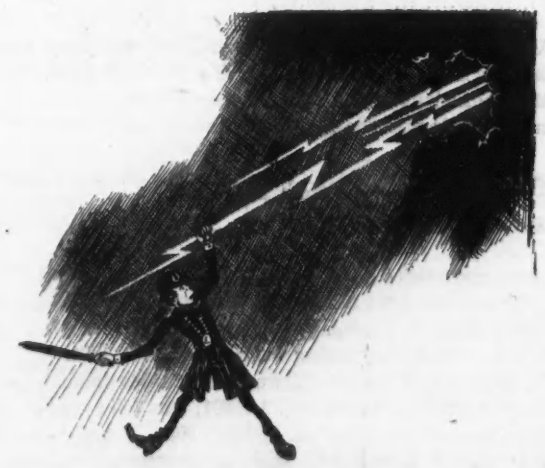
A few years ago we were accustomed to associate electricity with a wire and a battery, or a Leyden jar or a something; to-day we believe the wire to be but an incidental instrument in the propagation of energy—a something which makes its presence known through a particular distance or in a particular space. A few years ago we inadvertently conceived that we *made or generated* electricity; to-day we consider that the universe is an infinite sea of energy in which all matter is but incidental, all bodies but temporary or momentary constructions through which or by which this unseen energy may become apparent to our senses.

The certainty of these facts presents to my mind the greatest possible benefits for our future race. Not only is there opened an avenue of communication from one extremity of the universe to the other, from the distant star to this planet a pathway opposing no resistance to the speeding waves of energy, but it seems almost to offer a physical link between the Supreme Ruler our race demands and His realm. May it not be conceived that the ether is the pathway over which the messengers of Omnipotence reach organized matter?

The World's Electrical Congress.

Prof. Elisha Gray, chairman of the committee on the Electrical Congress to be held in 1893, has recently presented the preliminary address of the committee. This address is also signed by Col. R. C. Clowry and Prof. H. S. Carhart. To the address is appended a list of the names of those composing the advisory council for the Congress as at present constituted. The names of the American members have already been published in our columns. The foreign members of the council are as follows:

Sir William Thomson, F. R. S. (Lord Kelvin), Glasgow, Scotland; William H. Preece, F. R. S., London, England; Prof. W. E. Ayrton, London; Lord Rayleigh, Witham, Essex, England; Prof. S. P. Thompson, London; Prof. E. Mascart, Paris, France; E. Hospitalier, Paris; Dr. Werner Siemens, Berlin, Germany; Prof. H. Von Helmholtz, Berlin; Prof. Galileo Ferraris, Turin, Italy; Joseph Kareis and K. K. Baurath, Vienna, Austria; Prof. Dr. Weber, Zurich, Switzerland; Prof. E. Gerard, Liege, Belgium; Prof. A. Repman, Moscow, Russia; Prof. A. Stoletow, Moscow; S. Yslas, City of Mexico, Mexico, and the Director-General of Telegraphs, Madrid, Spain.



A Lightning Arrester.

A New Automatic Engine.

Several views and a section herewith given of a single valve automatic engine, recently brought out by the J. H. McEwen Manufacturing Company, of Ridgway, Pa. The object of the designers has been to avoid parts liable to derangement through attempts at adjustment by unskilled engineers, and to obtain close regulation, economy and smooth running. The centrifugal action of the connecting rod, etc., is balanced by counterweights in the crank discs. The effect of the inertia of reciprocating parts has received considerable attention, and the compression is so adjusted as to balance the momentum of these parts at the end of stroke. Due consideration has been given to the method of lubrication; shields over the discs prevent the oil from being thrown over the engine room; the oil and drip from different parts of engine are led to inside of frame and are drawn off through a pipe. A flanged trough at the lower outside edge of the frame prevents any outside drip from reaching the foundation or floor. The frame has received its share of study so as to obtain rigidity, and enable it to resist, without flexure or vibrations, the stress to which it is subjected.

The main bearing and the crank end of the connecting rod are of similar construction. The caps are adjusted by being drawn up against thin strips of fine calendered paper, and admit of very delicate adjustment. The lining of the bearings is of babbitt metal, carefully scraped and fitted, and can be easily removed if necessary for renewal.

The crankshaft is made of one solid piece of forged steel The counterbalance discs are of cast-iron fastened to the steel crank by keys. After being keyed they are turned and polished.

The piston is made hollow and wide, giving plenty of wearing surface. It is packed with cast iron rings that are made eccentric, somewhat larger than the bore of the cylinder, and are sprung into grooves in the piston, their elasticity keeping them out. The piston head is forced on the rod with hydraulic pressure and riveted. The other end is threaded and screwed into the crosshead and fastened with a jam nut.

The crosshead is of cast steel, and has large bearing surfaces, the length being equal to the stroke of the engine in all cases. The pin is of steel accurately fitted and forced in with hydraulic pressure.

The design of the valve motion is such as will change the lead with the load; this tends to equalize the compression, and is an aid to quiet running; for with a constant lead the compression is much greater at an early cut-off than at a late one, and if the compression balances the reciprocating parts with a light load it cannot when the load is heavy.

The construction of the valve and the new design of governor are two notable features of the engine, which greatly contribute to the steadiness of its running under a great variation of load.

The valve shown in Fig. 1 is provided with a balance plate having port openings of the same dimensions as the ports on the opposite side leading directly to the cylinder, as shown.

The ports in the balance plate lead around the valve, both above and below, meeting the passages leading from the ports on opposite side to the cylinder, where each passage is increased in area to equal the sum of the areas of the passages up to this oint. Care is taken that the port openings on each side shall be of exactly the same dimensions and directly opposite each other. With this arrangement the valve is perfectly balanced, and the friction which is due to the weight of the valve is very small, and will do no harm. There is no pressure to force the valve against either face, and consequently there can be little wear or leakage.

The valve, valve seat and balance plate are carefully scraped and fitted, and the construction of the balance plate is such that, if the pressure in the cylinder is greater than in the steam chest, the valve and balance plate will leave their seats, permitting the free escape of water without injury to the engine.

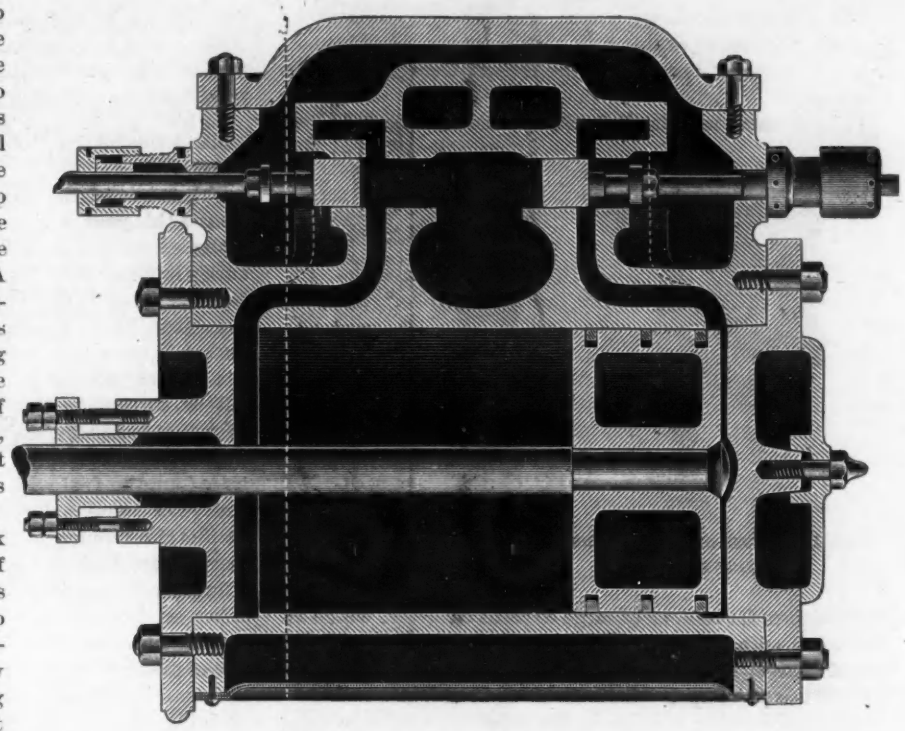


FIG. 1.—VALVE ARRANGEMENT OF THE McEWEN ENGINE.

The governor shown in Fig. 3 is very simple in its construction and action. It appears to be well adapted to keep the engine running at a uniform speed under all conditions of load and steam pressure (provided there is pressure enough to do the work); it is sensitive to small variations in load, and its action under greater variation is quick; it is very stable, thereby preventing small periodical fluctuations in speed; it is not so delicate as to be materially affected by friction, wear or want of lubrication, or by incorrect adjustment of spring, and operates well with fly-wheels of any desired weight or size, or at any speed.

The action of this governor is partly controlled by the centrifugal force of the weight *A*, and by the inertia of the heavy weight *B*.

The inertia weight *B* is free to swing on the pivot *P*, and has rigidly attached to it the pin *G*, from which the motion of the valve is derived; in fact, the pin *G* may be considered to be the eccentric of the engine. The dash pot *E* is simply an air cylinder with a loosely fitted piston connected with the arm *D*. Its position is radial, and the centrifugal action is in line with the cylinder and the piston, and will not produce enough friction to require lubrication. By the addition of this cylinder the stability of the governor is increased to such an extent that its action will not be destroyed by increased friction of any of the moving parts, or by an incorrect adjustment of the spring. It may be taken apart and put together by any workman not familiar with its mechanism without danger of having its action destroyed. The combination of the air cylinder and inertia weight also makes it possible and safe to use a very small and light fly wheel, if so desired, and to run the engine at any desired speed.

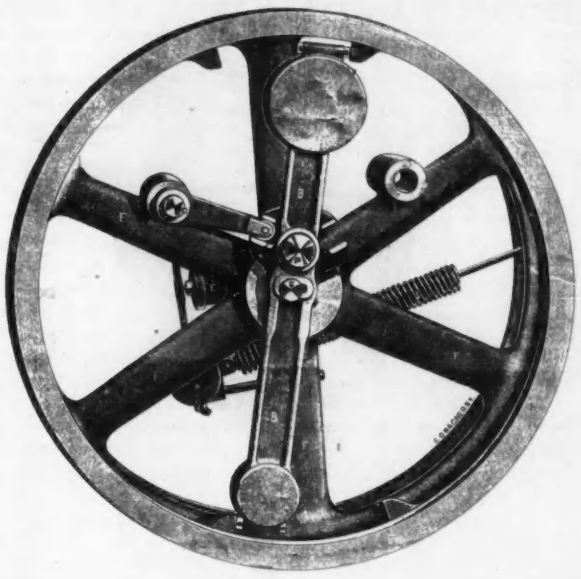


FIG. 3.—GOVERNOR OF THE McEWEN ENGINE.

In testing at the works a 16 × 18-inch engine, running at the rate of 200 revolutions per minute, to see what effect a light fly wheel would have upon its regulation, there was used a 54-inch fly wheel weighing 1,200 pounds. With this wheel the engine, it is said, gave perfect regulation. So far as could be discovered by speed indicator or tachometer it did not vary one revolution between no load and 217 h. p., or from varying steam pressure. At this test it was demonstrated that the governor could be so adjusted that the engine would run faster when loaded than when light, without any tendency to race or change its speed under varying steam pressure.

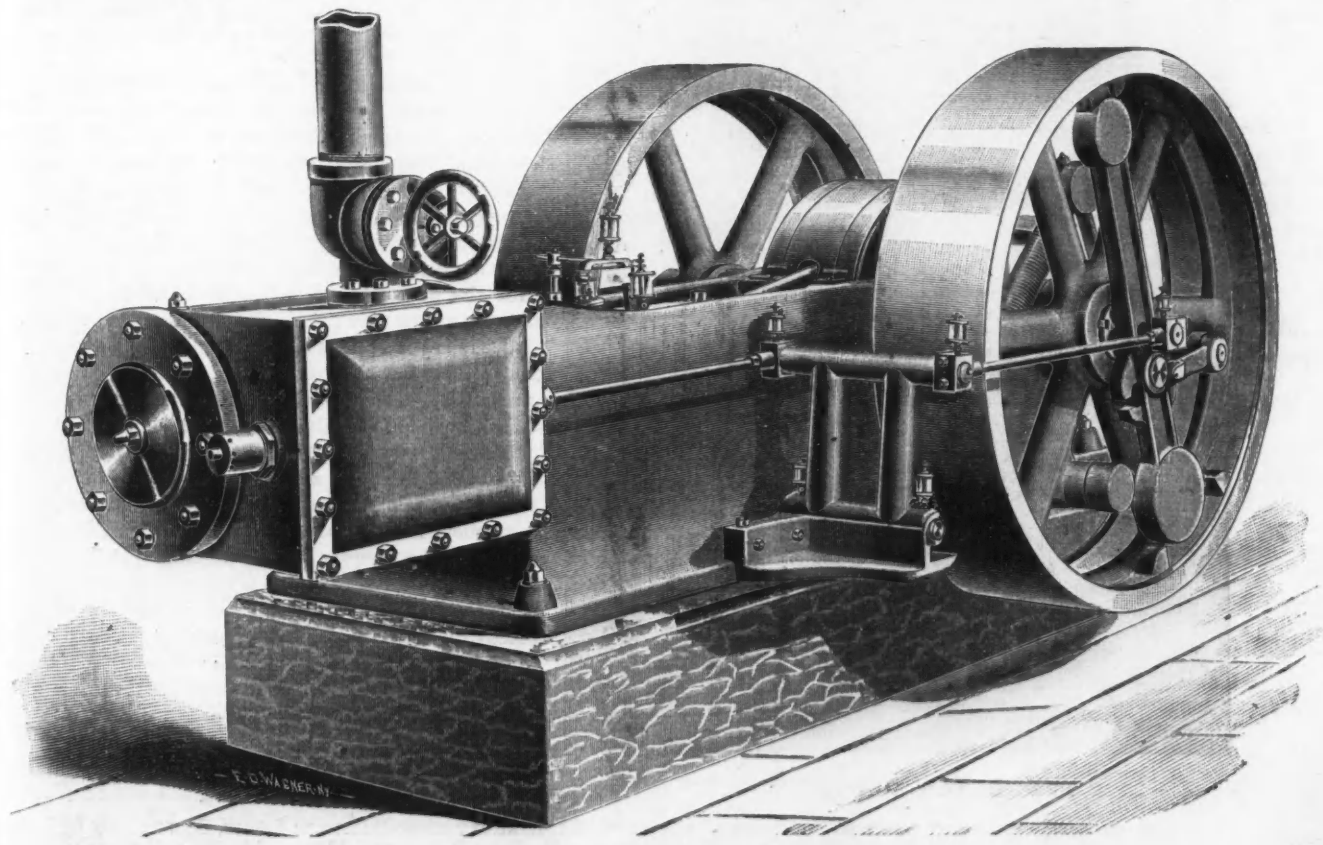


FIG. 2.—GENERAL VIEW OF THE McEWEN ENGINE.

COMBINATION PLIERS.

Combination Pliers.

We show in the illustration combination pliers which are being manufactured by the Cincinnati Tool Company, of Cincinnati, O. They are made of the best steel, well tempered and finished and form a convenient combination of flat nose and gas pliers with wire and side cutters, while the ends of the handles afford service as a screwdriver and a reamer.

Pendent Switches and Cut-Outs.

We show in the illustrations several types of combined pull switches, pendant cut-outs and pendent pull switches, which are the invention of Mr. E. T. Greenfield, electrician of the Interior Conduit and Insulation Company, of New York. These goods are made in a variety of forms, a brief description of some of which is given below.

Fig. 1 illustrates the interior mechanism which is employed in the different styles of switches and is concealed within the shells of the same. This new form of switch overcomes in every way the difficulties experienced in turning on and off any style of key socket suspended from flexible pendants. Grasping either the cord or lamp with the hand, the light may be turned on or off by a slight pull only. This form of switch will be found very advantageous for use, it is stated, in place of a key socket or

Fig. 2.—Pendent Switch.

other switch in circuit, as in clothes closets and in like places where the lamp is in reach of the hand.

Fig. 2 illustrates the switch made to fit the standard conduit branch junction boxes and cut-outs, manufactured also by the Interior Conduit and Insulation Company, and Fig. 3 represents the switch as adapted to the base of their "V.V." ceiling cut-out. The same mechanical principle employed in the combined pull switch and ceiling pendent cut-outs is used to great advantage in the pendent pull switches, cuts of which appear herewith.

Fig. 4 is a pendent pull switch, designed for attachments to flexible cords for controlling incandescent lamps with the same freedom and safety as is experienced in handling an ordinary push-button on an annunciator circuit. The switch may be used as a pendent from the centre of electroliers, thus dispensing with key sockets, and affording ready means for easily controlling the current. In general it serves to bring within control lamps that are otherwise out of reach, permitting them to be turned on and off from any point that may be reached by a flexible cord. These switches are easily and quickly wired, and, it is claimed, are thoroughly reliable in every respect, and are of fine workmanship and finish.

A New Oil Pump.

An important adjunct to an engine is an oil pump, and we show in the illustration a glass body oil pump which is

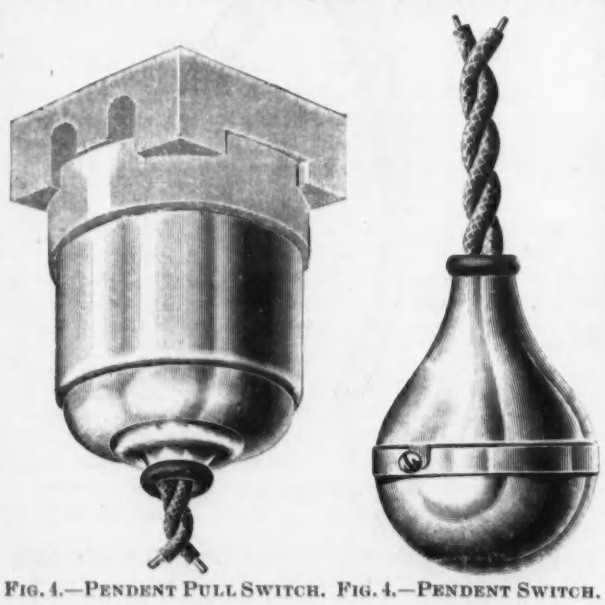


Fig. 4.—Pendent Pull Switch. Fig. 4.—Pendent Switch.

intended as an auxiliary to the sight feed lubricator. With this pump it is stated that any amount of oil can be supplied to the cylinder at any time, the glass body showing the amount of oil remaining in the tube. The advantages of having a ready supply of oil which can at any time be supplied to the cylinder can be seen, as considerable annoyance might result were an accident to happen to the sight feed lubricator in the breaking of the glass tube. The pump shown in the illustration is manufactured by the Lunkenheimer Brass Manufacturing Company, of Cincinnati, O. These pumps are simple and practical in construction, durable, efficient and very ornamental, and are warranted by the manufacturers. They have been adopted by leading engine builders in the United States, it is stated, and are highly indorsed by them and thousands of other users. They are made strictly first class, in two sizes, holding one-third and one pint respectively, and furnished highly finished either in brass or nickel plated.

New Edison Rheostat.

The illustration shows a new starting and controlling rheostat for motors running on high voltage current which has been recently designed by the Edison General Electric Company.

This rheostat is a modification of the standard Edison

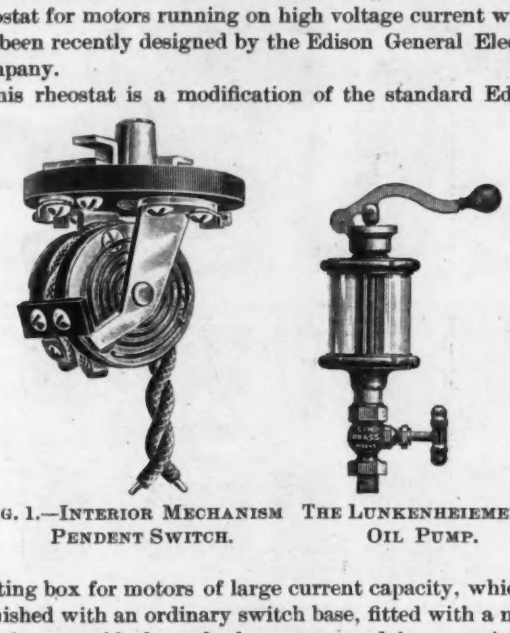
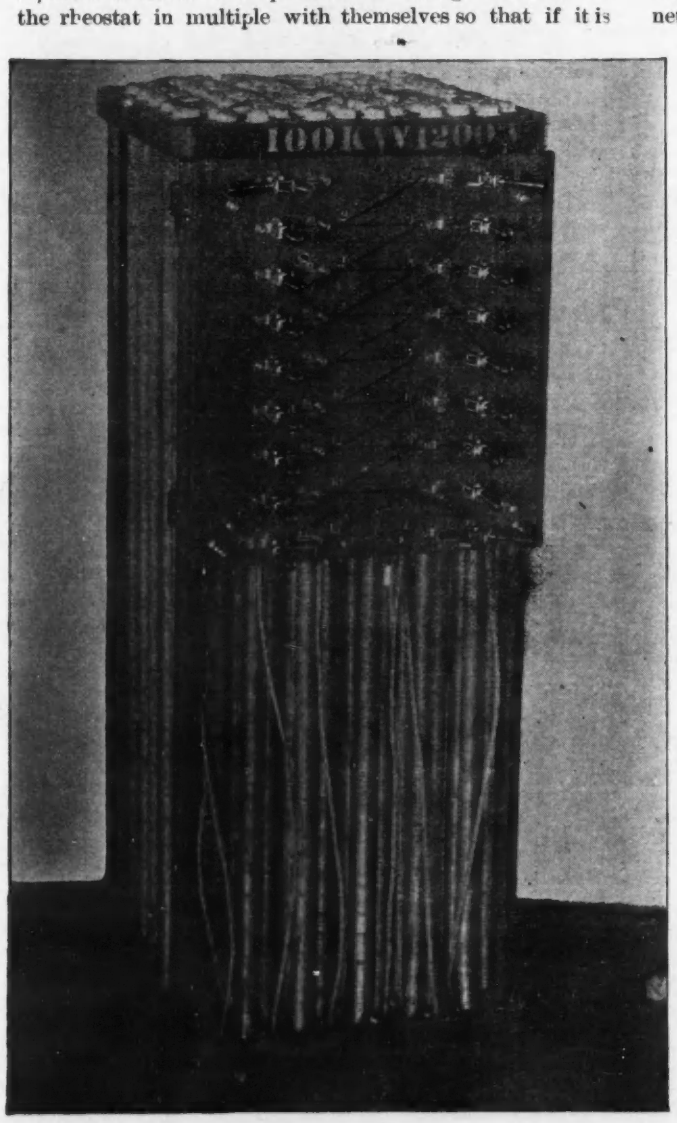


Fig. 1.—Interior Mechanism Pendent Switch. The Lunkenheimer Oil Pump.

starting box for motors of large current capacity, which is furnished with an ordinary switch base, fitted with a number of contact blocks and plates, arranged in a semicircle around the pivot upon which turns the switch arm.

The modification consists in the substitution of a switchboard with several separate and distinct switches, in place of the ordinary board. By the employment of several separate switches it is possible to arrange the coils of the rheostat in multiple with themselves so that if it is



NEW EDISON RHEOSTAT.

required to carry a larger current, or remain in circuit constantly for the purpose of reducing the speed of the motor, it is comparatively simple to manipulate the switches according to requirements. The resistance is built up of tinned iron wire wound in spirals, arranged in sections.

The rheostat shown in the cut is designed to start and control the speed of a 100-k. w. motor, working on a 1,200-volt circuit. The range of resistance is very wide, it is stated, its greatest resistance being 72 ohms, while, with the switches properly arranged, it can be reduced to .25 of an ohm, the current carrying capacity for the smaller resistance being increased in the same proportion. The overall dimensions of the box shown in the cut, designed for an electric mining plant, are: Height, 5 feet, 6 inches: width across switchboard, 28 inches; depth, 26 inches.

Rheostats of this design are said to be absolutely fireproof, are strong and substantial in construction, and have been arranged with a view to securing a high insulation resistance.

NEW BOOKS.

Dynamo-Electric Machinery. By Silvanus P. Thompson. Fourth Edition.

It is now announced by the publishers that this long expected book will be ready May 1. It has been thoroughly revised and contains about 1,000 pages, as compared with 670 pages in the third edition. An important addition to the book has been made in the way of plates. Thirty-nine of these will accompany the new edition. The price of the book in cloth binding will be $9.

Magnetic Induction in Iron and Other Metals. By J. A. Ewing. 351 pp., 159 ills. Price $4.00. The Electrician Printing and Publishing Company, 1892 (First Notice).

This is one of the most important books that has appeared this year, and coming from an author of such an established reputation it will be looked upon as an undoubted authority upon the important subject of which it treats. No man is better fitted for the task of discussing these questions than Prof. Ewing. In attempting this work the author has not approached the matter from the standpoint of the scientific historian. He has been more concerned, he tells us, to deal with things discovered than with discoverers. In many instances, therefore, the work of early observers is passed over without mention because later experiments were found to deal with the same points in a more conclusive or more exhaustive way. Particulars which will facilitate reference to the original memoirs in which researches are described have in all cases been given for the assistance of those who wish to pursue the subject further. After an introductory chapter, which explains the fundamental ideas and the terminology, an account is given of the methods which are usually employed to measure the magnetic qualities of metals. Examples are then quoted, showing the results of such measurements for various specimens of iron, steel, nickel and cobalt. A chapter on magnetic hysteresis follows, and then the distinctive features of induction by very weak and by very strong magnetic forces are separately described, with further description of experimental methods, and with additional numerical results. The influence of temperature and the influence of stress are next discussed. The conception of the magnetic circuit is then explained, and some account is given of experiments which are best elucidated by making use of this essentially modern method of treatment. The book concludes with a chapter on the molecular theory of magnetic induction; and the opportunity is taken to refer to a number of miscellaneous experimental facts, on which the molecular theory has an evident bearing.

Guide to Electric Lighting, for the Use of Householders and Amateurs. By S. R. Bottone. 189 pp. 77 ills. Price 75 cents. Macmillan & Co.: New York and London, 1892.

We are surprised to see a book of this character coming from the press of these well known publishers. Its style is far from clear, its definitions of electrical terms and apparatus obscure, its illustrations of poor quality, and in some cases almost unrecognizable, while the entire subject has been treated in a very disjointed and unsatisfactory answer. The title page of the book indicates that it is intended "for the use of householders and amateurs," but it is difficult to see why it is necessary to talk about strains and stresses in conductors in explaining electrical phenomena for this class of readers. Two specimens will serve to illustrate the vague character of some of the definitions. In explaining the mode of working of the primary battery the author says, "When an acid acts chemically on zinc a certain stress is set up which, if the conductor is placed in circuit so that the strain can relieve itself, produces in its turn a current." And again in the chapter on the dynamo it is stated that this "instrument" "consists essentially of a magnet either permanently or temporarily excited, near the poles of which can be moved (generally rotated) a piece or pieces of iron around which layers of wire are coiled, known as the 'armature.'" Just what particular value this kind of information may be to the popular reader we are unable to say. American readers will find Atkinson's book on electric lighting a much more satisfactory guide than this one.

Electricity up to Date for Light, Power and Traction. By John B. Verity. 178 pp., ill. Price, 75 cents. Frederick Warne & Co.: New York and London.

This little book is intended, not for the technical reader, but for the general public, and the author has endeavored to describe in popular language the general principles of electric lighting and electric power transmission systems. As a rule, books of this class usually contain considerable interesting reading, and convey to the popular mind a good deal of information more or less accurate of the generation and use of electricity for industrial purposes. This little work of Mr. Verity's contains thirteen chapters treating of the different methods of producing electricity, the dynamo, electric lighting, the storage battery, the wiring of a house, arrangement of private systems, the public supply of electricity, electric transmission of power, electric railways, and similar subjects.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 9, 1892.

The market has not developed anything of special interest during the week to change the conditions which have been predominant there for a long time. The day of the quarterly disbursements has passed without materially affecting matters. There seems to be no actual cause for the quietness and, at times the unsteadiness in prices, but since most of the interest in speculation centres in a few stocks, their fluctuation directly affects the course of the other stocks. This is inevitable on such a market as the present one. Money is easier than ever before and the rates remain about the same, a great contrast to what they were one year ago when money at the clearing houses was worth even six and seven per cent. Cheap money is a desirable feature when trade is active, but at present there is little or no call for it, as the general conditions of the mercantile business are at a low ebb.

The Electric Stocks have retained their usual degree of strength during the week, and have suffered little or no fluctuation. They are very quiet now, and only small sales are made. Thomson-Houston closes at the end of the week a point higher than it has been. Fort Wayne has fallen off a fraction. Westinghouse remains at the same figure with very few sales. The latest report as to this company entering the consolidation sets the figure at $30 per share for the common stock and a guarantee of dividends on the preferred. At such a figure as this further negotiations have ceased, and there seems to be as little chance as ever of any combination. Edison General Electric advanced 1½ points and stood 98½-99¼ at closing.

Western Union Telegraph.—Stock showed quite an advance on Friday of this week, and it is reported that the next quarterly dividend will be at the rate of six per cent. instead of five per cent. An increased dividend rate has been considered by the company's directors, and it is stated is favored by some, not by others, and this reported increase accounts for the rise. To-day Western Union sold at the highest price in 10 years, closing at 89¼-89⅝, an advance of 2⅜ for the week. It has also been reported that an increase in the share capital, $13,000,000 or $14,000,000, to $100,000,000, issuing new stock to represent net earnings expended upon the plant, is contemplated, but this the management denies.

Annual Reports.—The Northwest Thomson-Houston Electric Company held its annual meeting in St. Paul, Minn., on April 4. Officers and directors were elected as referred to elsewhere in this issue. This company, under an exclusive license from the Thomson-Houston Electric Company, of Boston, sells Thomson-Houston apparatus in Washington, Oregon, Idaho, Wyoming, Montana, North Dakota, South Dakota, Minnesota and Northern Wisconsin. The main office of the company is in St. Paul. Branch offices have been established in Portland, Helena, Tacoma and other points in that locality. The total volume of business from June 1, 1891, to March 19, 1892, the end of the fiscal year, aggregated $1,934,000, being at a rate of $2,700,000 per annum. At the present time there are in the territory covered by this company 75 lighting companies and 33 railways using Thomson-Houston apparatus. The capital stock of the company is $750,000 of common stock and $750,000 of preferred stock. This preferred stock is entitled to receive quarterly dividends at a rate of 8 per cent. per annum. The company has earned and paid two quarterly dividends of 2 per cent. each on the preferred stock and one of 2 per cent. on the common stock, besides the one which has been declared payable this April 15. The following shows the condition of the company at the close of the fiscal year, March 19, 1892:

ASSETS.

Franchise	$110,000.00
Fixtures, merchandise, work in progress, etc	769,481.01
Merchandise in transit	25,911.97
Stock of other companies at conservative basis	178,047.19
Bonds of other companies at conservative basis	168,300.00
Notes receivable	129,613.75
Accounts receivable	757,111.55
Due from agents and others	30,375.43
Cash on hand	242,706.81
	$2,411,547.71

LIABILITIES.

Capital stock, common		$750,000.00
Capital stock, preferred		750,000.00
Notes payable		577,519.23
Accounts payable		58,346.17
Due T.-H. E. Co., Boston		42,865.48
Contingent account		43,427.12
Surplus, June 1, 1891		$100,600.88
Gain, June 1 to Dec. 1	$89,808.46	
Less dividend Dec. 15	$10,072.00	
Less dividend Jan. 15	15,000.00	
Less dividend March 15	12,400.00	
	37,472.00	
		52,336.46
		152,937.34
Gain, Dec. 1 to March 19	71,452.37	
Less added to contingent account March 19, 1892	35,000.00	
		36,452.37
Surplus and undivided profit, March 19, 1892		189,389.71
		$2,411,547.71

The annual report of the Wyoming (O.) Water, Light, Heat and Power Company shows a net income of 3¾ per cent., or a gross income of 5¾ per cent from the investment.

Dividends.—The Laconia, N. H., Electric Light Company has declared a semi-annual dividend of six per cent. The Malden (Mass.) Electric Company has declared a quarterly dividend of $2 per share, payable April 15. The Northwest Thomson-Houston Electric Company has declared a dividend of two per cent. on the common stock, payable April 15.

To Issue Bonds.—The directors of the Wyoming (O.) Water, Light, Heat and Power Company are authorized to issue bonds not to exceed $15,000, to run 10 years, bearing six per cent. interest, for the purpose of improvements and extensions to the plant.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, April 9, 1892, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
American Telegraph Co.	100	14,000,000	60	63
Western Union Telegraph Co.	100	86,200,000	89½	89⅝
Commercial Cable Co.	100	7,716,000	153	154½
Edison General Electric	100	15,000,000	98½	99¼
Edison Illuminating Co., of New York	100	4,500,000	81½	82½
" " " Brooklyn	100	750,000	76	80
" " " Chicago	100	750,000	138	142
U. S. Illuminating Co.	100	1,250,000	30	35
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
Edison Elec. Light Co. (of Europe) bonds	sh	30,000	65	75½
" Ore Milling Co	100	2,000,000	15	20
" Toy Phonograph Mfg. Co	10	1,000,000	....	½
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co.	..	500,000	20	40
East River Electric Light Co.	100	1,000,000	....	60
North American Phonograph Co.	...	6,600,000	5	8
New York Phonograph Co.	...	2,000,000	3	4
Automatic Exhibition Co.	...	2,000,000	3	6
New England Phonograph Co.	...	2,000,000	1¾	2¾

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.	25	6,000,000	59¼	58¼	59⅛	59½
Thomson Houston Elec. preferred	25	4,000,000	28½	28¼	28⅝	28½
Thomson-Houston Elec.—Series C	sh	40,000	8½	....	8½	9
Thomson-Houston Elec.—Series D	sh	120,000*	....	....	7	7⅛
Thomson-Houston Int'n'al Elec.	100	600,000	....	....	200	225
Thomson-Houston Int'n'al Elec—Pfd.	100	400,000	....	....	101	103
Thomson Elec. Weld.	100	1,000,000	....	....	55	60
Thomson European Elec. Weld	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	28½	28	28	28¼
Westinghouse Elec.—Pfd.	..	4,000,000	45½	44	44	45
" " —Trust receipts	..	10,000,000	17	....	17	17½
Fort Wayne Elec.	25	4,000,000	13	12¾	12⅞	....
Fort Wayne Elec.—Ser. A.	sh	80,000	....	....	7	7⅛
Detroit Elec	10	1,000,000	7⅛	7	7½	8
West End St. Ry. Co.—Com	50	7,150,000	74⅛	73⅞	74	74¼
West End St. Ry. Co.—Pfd	50	6,400,000	86½	85¾	86¼	86½
American Bell Tel	100	15,000,000†	197	193¼	198½	199
Erie Tel. & Tel. Co.	..	4,800,000	46¼	46	46	46¼
Mexican Tel. Co.	10	1,280,000	1.05	....	1.00	1.10
New Eng. Tel. & Tel. Co.	..	10,304,600*	....	....	51¼	52c.
Tropical Tel. Co.	10	400,000	....	....	45c.	50c.

* Ex-dividend.
† Ex-rights, 13½.

NEW INCORPORATIONS.

The New Omaha Thomson-Houston Electric Light Company (amended articles), of Omaha, Neb., $1,100,000. Incorporators, E. S. Wily, H. E. Chubbuck and John L. Martin, of Omaha, Neb.

The Citizens' Electric Company, of Green Bay, Wis., capital stock $25,000, has been formed to generate electricity for light, heat and power. J. H. Ebeling, H. W. Hart and F. B. Warren are the incorporators.

The Hinton Electric Light and Power Company, of Hinton, W. Va., capital stock $50,000, has been formed to furnish light and power, etc. The promoters are R. F. Van Antwerp, J. A. Parker and L. P. Graham, all of Hinton.

The Mifflingtown Electric Light Company, of Mifflingtown, Pa., capital stock $2,500, has been started to supply electric lights to that town. The promotors are Ezra C. Doty, Jno. J. Patterson, Jr., and B. F. Burchfield, all of Mifflingtown.

The Patterson Electric Light Company, of Mifflingtown, capital stock $3,500, has been formed to supply lights by means of electricity to the borough of Patterson, Pa. Ezra C. Doty, John J. Patterson, Jr., and B. F. Burchfield are the organizers.

The Waldron Electrical Company, of Berwick, Me., capital stock $50,000, has been formed to manufacture and deal in all kinds of electrical machinery. The promoters are Charles H. McIntire, Ezra C. Pratt and Jesse J. Smith, all of Lowell, Mass.

The Canton Electrical Company, of Canton, Mo., capital stock $4,500, has been formed to furnish electric light, heat and power to the citizens of Canton. The incorporators are W. E. Agee, T. L. Durhee and W. B. Horton, all of Canton, Mo.

The Buffalo and Hamburg Railway Company, of Hamburg, N. Y., capital stock $150,000, has been started to build and operate an electric railroad. Cyrus T. Wheelock, John H. Meech, both of Buffalo, and Amos Baker, of Hamburg, are the organizers.

The Foreign Storelectro Company (incorporated in W. Va.), of Cleveland, O., capital stock $1,500,000, has been organized to manufacture and sell electrical instruments, etc. J. C. Hoyt, A. C. Dustin and M. L. Black, all of Cleveland, O., are the incorporators.

The Kenosha Electric Street Railway Company, of Kenosha, Wis., capital stock $100,000, has been formed to build and operate a street railway in Kenosha, and to furnish light, etc. J. W. Munson, H. Pennoyer and H. E. Robinson are the incorporators.

The Hope Electric Appliance Company, of Portland, Me., capital stock $300,000, has been formed to manufacture and deal in all kinds of electric machinery and apparatus. Augustus Wright, Robert Fessenden and P. Gifford, of Providence, R. I., are the organizers.

The South Side Passenger Railway Company, of Williamsport, Pa., capital stock $15,000, has been incorporated to operate an electric railway in Williamsport. J. Henry Cochran, James B. Krause and Henry C. McCormick, all of Williamsport, are the incorporators.

The Eastern Compound Wire Company, of Jersey City, N. J., capital stock $100,000, has been formed to manufacture and sell electrical conductors of all sorts, etc. C. Stewart, W. F. Pascoe, of Easton, Pa., and C. H. McIntire, of Newark, N. J., are the incorporators.

The Denver Electric Company, of Denver, Colo., capital stock $500,000, has been formed to furnish electricity for light, heat and power, etc. Job A. Cooper, Chas. L. McIntish, Geo. W. Trinible, Absalom V. Hunter and Chas. Boettcher, all of Denver, are the incorporators.

The Wheeling & Belmont Railway Company, of Martin's Ferry, O., capital stock $100,000, has been formed to construct and operate a street railroad, to be operated by electric or other motive power. Harry Northwood, Joseph T. Hanes and Theodore Keller are the organizers.

The Iona Manufacturing Company, of Portland, Me., capital stock $15,000, has been organized to manufacture and deal in electric gongs, bells, batteries, etc. Norman Marshall, of Boston, Mass.; Henry P. Stanwood and John O. Holman, of both of Brookline, Mass., are the promoters.

The Vallamont Passenger Railway Company, of Williamsport, Pa., capital stock $10,000, has been formed to operate an electric railway in Loyalsock township, Lycoming county, Pa. The organizers are James B. Krause, E. R. Payne and Henry C. McCormick, all of Williamsport, Pa.

The Rocky Mountain Electric and Power Company, of Pueblo, Colo., capital stock $500,000, has been incorporated to furnish electricity for light and other purposes. Moses L. Stern, David F. Urmy, Geo. H. Hobson, E. C. Humphrey and Geo. W. Robinson, all of Pueblo, are the promoters.

The Palestine Water and Power Company, of Palestine, Tex., capital stock $100,000, has been incorporated to produce and furnish electricity for light, heat and power. Carlos S. Greeley, Dwight Treadway, Melvin L. Gray, Sam. G. Kennedy and N. Oscar Gray, of St. Louis, Mo., are the incorporators.

The Electrical Advertising and Display Manufacturing Company, of Camden, N. J., capital stock $500,000, has been formed to manufacture and construct electrical machinery, etc. R. E. Tifft, T. W. Snower, W. A. Brissinger, J. W. Jennings, of Philadelphia, and S. H. Morrison, of Camden, are the organizers.

The St. Kanawha Falls Water Power Electrical Manufacturing Company, of Charleston, W. Va., capital stock $1,000,000, has been formed to concentrate, utilize and control the power of the St. Kanawha River for a distance of five miles, to supply motive power to dynamos for generating electricity, etc. M. Levi, J. C. Alderson and Levi Welch, of Charleston, are the organizers.

AFFAIRS OF THE COMPANIES.

The Brooks Underground Telegraph Company will hold its annual meeting Tuesday, May 3, at 195 Broadway, New York.

The New England Telephone and Telegraph Company will hold its annual meeting on Monday, May 2, at 11 A. M., for the purpose of electing directors, etc.

The Atlantic Postal Telegraph Cable Company will hold its annual meeting in New York, Tuesday, April 19, at 1 o'clock P. M., for the election of directors, etc.

The Spanish American Light and Power Company, Consolidated, will hold its annual meeting Tuesday, May 10, at 12 o'clock noon for the purpose of electing trustees, etc.

The Northern New York Telephone Company will hold its annual meeting at 18 Cortlandt street, New York, at 11 o'clock A. M., Wednesday, April 27, for the election of officers, etc.

The Postal Telegraph Company has sold to the Postal Telegraph Cable Company the line of telegraph within the States of Illinois and Wisconsin for a consideration of $25,000, it is stated.

The Brush Electric Illuminating Company will hold its annual meeting at 204 Elizabeth street, New York, Monday, April 18, at 12 o'clock M., for the purpose of electing trustees or directors, etc.

The Mexican Central Telegraph and Telephone Company will hold a special meeting of the stockholders on April 23, at 11 A. M., to consider and act upon a proposition for the sale of its property to and a consolidation with the Mexican Telephone Company.

The Indianapolis street railway lines, of Indianapolis, Ind., have, it is stated, been purchased by a syndicate of New York capitalists, and that the control of the roads will pass into its hands on May 10. It is reported that R. L. Belknap, of New York, heads the syndicate.

The Northwest Thomson-Houston Electric Company held its annual meeting in St. Paul, Minn., on April 4. The following directors were elected for the ensuing year: E. I. Garfield, V. M. Watkins, Maurice Auerbach, Joseph Lockey, H. M. Byllesby, Howard C. Levis, B. F. Meek, Jr. The following officers were elected: H. M. Byllesby, president and treasurer; B. F. Meek, Jr., secretary and assistant treasurer.

The Mexican Telephone Company will hold its annual meeting at the Astor House, New York, at 11 o'clock A. M., Wednesday, April 20, for the purpose of electing seven directors for the ensuing year, acting upon the proposed purchase by the company of the property and franchises of the Mexican Northern Telegraph and Telephone Company and of the Mexican Central Telegraph and Telephone Company, and transacting such other business as may legally come before said meeting.

The Wyoming Water, Light, Heat and Power Company, of Wyoming, O., held its annual meeting recently. The stockholders elected William Schuberth, Jr.; R. D. Barney and Will Stearns directors for three years. The board of directors organized by electing William Schuberth, Jr., president; R. J. Hyndman, vice-president, and Charles T. Slack, secretary and treasurer. The directors were authorized to issue bonds, noted elsewhere in this issue, for the purpose of making extensions to the plant, in consideration of the fact that the village of Lockland has contracted for electric lights and Arlington Heights desires the same improvements.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, April 12, 1892.

Prof. Elisha Gray, of Chicago, was in the city last week.

Mr. John M. Clower, dealer in electrical supplies, Dallas, Tex., is in New York making purchases.

Mr. Charles E. Chapin, whose offices are at 136 Liberty street, has been appointed general Eastern agent for the sale of the Packard incandescent lamps.

The Electric Lock illustrated in last week's issue of THE ELECTRICAL WORLD is the invention of Mr. Adam Lungen, who is a member of the firm of Edwards & Co., the manufacturers.

Prof. Robert Spice will lecture on "Long Distance Transmission of Electric Power," with illustration, before the Brooklyn Institute of Arts and Sciences on Friday evening, April 15.

The Empire City Subway Company will hold its annual meeting at the office of the company in this city, on Tuesday, April 26, at 12 o'clock noon, for the election of directors and the transaction of other business.

Mr. Harris E. Johonnot, of Newton, Mass., called at our office last week. Mr. Johonnot is an electrician and also does a general electrical business in all kinds of electrical apparatus, installing and repairing plants, etc.

The Metropolitan Telephone and Telegraph Company will hold its annual meeting at the office of the company in this city on Tuesday, May 3, at 12 o'clock noon, for the election of directors and the transaction of other business.

Mr. Joseph Lee, of 204 Reade street, has in operation eight Eddy motors, ranging from 10 to ½ h. p. each. Mr. Lee is making a specialty of installing and repairing motors, and his connection with the trade for the past 10 years makes his services very valuable to the users of motors and those intending to install plants.

Electric Wiremen to Strike.—It is stated that another strike of electric wiremen has been ordered, and that over 300 men have been ordered to strike by a resolution passed at a special meeting of the Electrical Wiremen's Union. About three months ago the Union notified all firms in the city employing electric wire-

men that it would demand $3 a day paid each wireman after April 10. The time has expired and no attention has been paid to the demand, it is stated, except by two firms.

Mr. E. Peckham, of the Peckham Motor Truck and Wheel Company, Kingston, New York, was in the city last week and took back to Kingston with him three very nice orders for trucks. The Atlantic Avenue Railway, of Brooklyn, gave him a first order for 50 trucks. The Coney Island & Brooklyn Railway gave him an order for 20 trucks, and the New York Electric Railway Company (formerly known as the Harlem & Morrisania) gave him an order for 60 trucks. Mr. Peckham says the work ahead will keep his factory busy for some time to come.

The General Electric Company corporation bill has passed the Assembly. When it was brought up last week for final hearing representatives Malby and Deyo attacked the bill incorporating the General Electric Company, on the ground that it granted a valuable franchise without proper compensation to the State, as by its provisions the company is to pay only one-twentieth of one per cent., instead of one-eighth of one per cent. that other corporations pay. The company, they thought, ought to be incorporated under the general law instead of by special enactment. Mr. Malby's amendment to increase the tax to one-eighth of one per cent. was lost, and the bill passed by a vote of 30 to 20. The bill as amended in the Senate provides that the company must pay a franchise tax of $10,000 before it begins business.

The cost of lighting Brooklyn is a matter of great importance with the municipal authorities, and the annual cost has increased from about $200,000 to over $530,000. As stated in THE ELECTRICAL WORLD of April 2, the budget of 1891 appropriated $530,000 for this year for lighting the city, and the bulk of this goes to the Citizens' Electric Illuminating Company, which furnishes lights to the main section of the city and controls the Municipal Electric Light Company, which lights the Eastern District. These concerns have been able so far to gain the exclusive franchise, and have put in bids to supply electric lights for $182.50 per light per year. Together they supply over 1,200 lights and get about $220,000 a year from the city. As these companies are putting up new lights every week or so, they will soon be drawing very nearly $300,000 annually from the city treasury, and the gas companies will get the balance.

The Electric Club.—The managers of the club held an important meeting last Thursday night which resulted in the issue of a call for a meeting last evening to take a vote on the advisability of authorizing the retiring officers to wind up the affairs of the organization. The club's heavy indebtedness and its increasing liabilities have led to the general opinion among the managers that this course was the best one to pursue. There was a large attendance at the meeting last evening, and the club's finances and other matters of interest to its membership were thoroughly discussed. Subscriptions were called for, and those present responded in a hearty manner, and before the meeting adjourned quite a large sum of money was raised toward liquidating the indebtedness of the club. Further subscriptions will be asked for. A resolution was passed instructing the board of managers to give up the lease of the present quarters and empowering them to make arrangements for more economical club rooms, to be run on a plan entailing less expense than heretofore borne by the club. It seemed to be the expression of those present that a hearty response from the present membership of the club would prevent the necessity of having to wind up its affairs, and if those called upon for subscriptions will respond in as hearty a manner as those who attended last evening's meeting no good reason can be seen why the club should not retain its charter and be a success. The meeting last evening was adjourned until next Monday evening when a full attendance is desired. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., April 11, 1892.

The Electric Light Station at Northampton was damaged by fire on the night of April 5. The dynamos in the station were more injured by water than by the fire.

Taking Telephone Testimony.—Commissioner Hallet has begun to hear the evidence in the Bell Telephone case. Alexander Graham Bell is the only witness heard so far.

The Thomson-Houston Company has recently taken the contract to install an electric light plant for the Bridgeport Ice Company, of Bridgeport, Conn. It is also equipping the Troy and Lansingburg Railway, and has already sold that road six W. P. 50-h. p. motors.

The Germania Electric Company has removed its manufacturing department from Cambridgeport to the new factory at Marlboro, Mass., to which place any shipments to the company should be made. Correspondence should be addressed to the company as heretofore at 505 Exchange building, this city.

The W. C. Young Manufacturing Company has been incorporated at Worcester with a capital of $35,000. The following are the directors: W. C. Young, president; J. E. Smith, Jr., treasurer, and E. F. Thompson. The corporation continues the business of W. C. Young & Co., manufacturers of lathes, machinists, tools, etc.

Newsboys Must Keep off the Cars.—The West End Railway Company will comply with the resolution of the Board of Aldermen in regard to newsboys boarding the cars of the company. At a meeting of the executive committee it was decided to lay the matter before the law department before any action toward its enforcement was commenced. It is presumed that the order will be immediately enforced, provided the law department does not place obstacles in the way.

E. S. Ritchie & Sons, of Brookline, Mass., are introducing the W. B. Luce pressure indicator. After a series of tests extending over many months in electric lighting stations where the conditions were most severe, the following points are claimed: The indicator will work inside of one-half volt either above or below the voltage to which it may be adjusted. It will work without variations. The temperature error is found to be so small that it may be neglected. It is easily adjusted. It is also unaffected by vibration.

The Committee on Railroads of the Legislature recently gave a hearing on the question of compelling the West End Street Railway Company to keep a record of accidents and report all accidents occurring except those to its own property. Mr. H. D. Hyde, counsel for the West End Railway Company, supported the idea that there was no need of such a record, as nine-tenths of the accidents occurring were settled at the office without suit being brought. Mr. Hyde cited instances where injured persons tried to collect by fraud damages from his company.

The Revere Rubber Company, of this city, is just introducing its Flexite flexible hard rubber tubing, which is always covered with its Flexite paint, is tough as leather and it is stated is absolutely indestructible from atmospheric action, not affected by oil, and is fire proof. This article has been prepared especially for interior conduit service, but is equally adapted to car wirings, covering feeder and leader wires on motors and dynamos and outdoor work generally, for wiring around awnings and cornices, turning sharp corners, passing through walls and around obstructions.

The Freeman Holland Company, of Boston, has closed a contract with the Hull Electric Light and Power Company for the installation of a complete lighting and power plant consisting of two 150 and one 125-h. p. engines, four 100-h. p. tubular boilers, two 1,500-light alternating current, dynamos, 4,000 light capacity of transformers and lamps, two power generators of 50,000 watt capacity each and about 25 miles of wire and pole construction. This is the first plant this company has undertaken. Mr. Walter K. Freeman has long been well known in the electrical field, especially in the line of alternating work. The Freeman Holland Company was organized in January of the present year, and has fitted up a factory at 514 to 530 Harrison avenue, and offices at 53 State street, Boston, Mass. It is equipped to manufacture 5,000 incandescent lamps per day and to build alternating and direct current dynamos, transformers and other apparatus pertaining to central station lighting

The Rapid Transit Report.—The commission is apparently of the opinion that the possibilities of transportation by means of street railways have been or are being developed in Boston to their fullest extent. That while with broader streets improved conditions could be obtained and while by the adoption of the plan proposed by the West End Company of running a tunnel under the Common and Tremont street certain advantages could be secured, yet even conceding these the problem of rapid transit would still remain an unsolved one, and it would be necessary to adopt other means for its solution. In treating of the subject the commission will cause surprise to those who had assumed that it would limit itself to the suggestion of some plan to regulate the running of the West End cars, to the construction of an elevated track across the city and to the widening of Tremont street by cutting a slice from the Common. It also makes recommendations in these particulars, but in the vastness of the general scheme these are simply treated as incidents of the general developments. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, April 9, 1892.

Mr. Edmund H. Sarran is finding ready sale for the premier motor and battery in Cincinnati.

Mr. George Manson, of the Okonite company, is one of the welcome visitors in Chicago this week.

Mr. J. W. Godfrey, general manager of the New York Insulated Wire Company, is having a successful western trip.

Mr. George P. Altenberg, the Cincinnati representative of the National Electric Manufacturing Company, of Eau Claire, has recently secured some very handsome orders for both lighting and power service.

Messrs. Sieberling & Butler, of the Indiana Rubber and Insulated Wire Company, of Jonesboro, Ind., visited the electrical trade in Chicago during the week and are well pleased with the outlook for the summer's business.

The Central Electric Company is preparing a house goods catalogue, which will be ready some time this month. It will be replete with cuts and other descriptive matter of the latest designs in this department of the company's business.

George Cutter reports many orders for his conduit connectors, which are used on many of the underground arc circuits in Chicago. They have been tested long enough to prove that they are well made and answer all the requirements of practice.

Mr. A. Irvine, formerly with the Kester Electric Company and who had just entered into the service of the National Electric Manufacturing Company of Eau Claire, died suddenly on Monday, in Pekin, Ill., presumably from paralysis of the heart.

Chicago Electrical Association.—Prof. C. S. Cook, of the Northwestern University, will deliver a lecture on the subject of "Hertz's Experiments" before the Chicago Electrical Association, Room 48, Athenæum Building, 26 Van Buren street, Tuesday evening, April 12, 1892.

Chicago Electric Club.—The members of the Chicago Electric Club met in Apollo Hall, Central Music Hall Block, on Wednesday evening, April 6, and listened to an address by Dr. W. R. Harper delivered before the Western Association of Engineers on the question of the proposed Institution of Technology.

Electric Lights for the Exposition.—The bids for the 87,096 incandescent lamps needed for the Exposition grounds were recently opened. The Thomson-Houston, the Edison General Electric, the Fort Wayne Jenney and the Brush electric companies all submitted proposals. Their bids were approximately the same, at $18.50 a lamp. The most striking bid was that of the South Side Machine and Metal Works, of Chicago, which was to furnish the entire plant at $6.60 a lamp, or a total of $439,469, which is about $12 lower per lamp than that of the larger companies. The Western Electric Company offered to furnish two dynamos of 13,000 lamps capacity each for the nominal sum of $1, and bids for 4,000 and 2,500 lamps were made by the Mather Electric Company, of Connecticut, and the Electrical Construction Company, of Chicago, respectively, for about $5.22 a lamp.

The Illinois Steel Company, of this city, has introduced a printing telegraph system in its mills by means of which apparatus the men at the reheating pits can inform those at the finishing end of the mill as to the heat numbers of the ingot, the ingot numbers, and the number of rails to each ingot, so that the proper number may invariably be stamped upon each rail that leaves the mill. In addition to these numbers, the "pit" and "hole" designations are also despatched by the same means. It is stated that, though the mechanism is necessarily somewhat complicated, its work is performed in a very satisfactory manner. The transmitter is in charge of one of the men at the reheating pit, and the receiving instrument is in charge of a boy, who reports on a blackboard for the use of the stamper the different numbers and letters as they are printed on the tape by the receiving instrument. The distance between the two is about 350 feet.

Hull House College Extension.—A course of six lectures on physics will be given at the Hull House, No. 335 South Halsted street during the spring. They will treat of the subject in an elementary nature, having in view a more comprehensive course in the fall. The importance of physics as a branch of electrical engineering is acknowledged, and it is hoped that those engaged in electrical work will give this course their hearty support. Physics is an interesting study, and the knowledge of it is of great practical value. It is the desire of the management of this course that the lectures be well attended. They will be given in the evening at 8 o'clock on the following dates: Introducing Remarks on Physic and the Determination of Units, Explanation of the Metric System, April 12. 2. The Laws of Motion, April 19. 3. The Forces of Nature, April 26. 4. Energy, May 3. 5. Heat, May 10. 6. Sound May 17. F. DEL.

Inquiries from Correspondents.

Queries to be inserted in this column must be of general electrical interest, and must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. No notice will be taken of questions which involve nothing more than can be found in elementary treatises on the subject. All correspondence should be as brief as is consistent with clearness. Readers are invited to send discussions and answers to these questions, which will be inserted in the column below.

[54.] How is it possible to reduce the speed of a motor by making it multipolar, without increasing the weight or keeping the same speed to reduce the weight? R. B. E.

[55.] What substance can I use to put between the segments of a commutator where the mica has been partially burned away? L. S.

[56.] What price should an electric light company, using meters, charge to compete with gas at $2 per 1,000 cubic feet? J. P.

[57.] How can I find the required number of ohms for winding a relay (the armature need move but once) and the number of dry cells necessary for six miles of No. 14 galvanized iron wire on porcelain insulators? Ditto for No. 9 galvanized telegraph wire? H. G.

[58.] How does a dry battery compare in strength with a wet battery? H. G.

[59.] Why is 50 volts used for the secondaries in the alternating system? A. E.

[60.] I have a small series incandescent dynamo, 1,300 volts, five ampères, which has given trouble by sparking badly around the commutator close up to the segment legs. It acts this way for, perhaps, 10 minutes, stops, and begins again, being worse at starting. Can you suggest the trouble and remedy? J. M. P.

[61.] What is the difference between sound, heat, light and electric waves? Is it supposed to be merely a difference of rapidity of vibration or are there other specific differences? L. A. J.

[62.] What causes the lights from an Edison No. 12 compound dynamo to flicker, and how can I prevent it? At the time of flickering the voltmeter has a variation of one or two volts; would this indicate that the speed caused the trouble? J. Y.

[63.] If two shunt dynamos, 200 volts, 20 ampères each, were connected up in series would it increase the pressure on the mains to 400 volts, and would it at the same time increase the pressure through the armatures of the generators to 400 volts? V. O. B.

[64.] In the above case with a pressure on the mains of 400 volts, could two motors wound for 200 volts be connected in multiple series, and if so would there be a pressure through the motors of 400 volts, and would the ampères also increase? V. O. B.

[65.] Why does an arc light dynamo reverse the current and burn the lamps upside down without apparent cause? This particular machine is a 35-light Western Electrical, 1,050 volts and 18 ampères. G. E. D.

[66.] Are files sharpened by electricity? If so, please describe the process, and refer me to some firm which does the work. H. S. D.

[67.] Text-books say "Never put different kinds of battery cells into the same circuit." Why not? H. S. D.

[68.] A circuit of 500 volts and 50 ampères is broken and 50 feet of wire inserted of such a size that it becomes red hot. This is removed and a wire of smaller diameter inserted, which melts. Does not theory say that decreasing the diameter will cut the current down so that the wire will not melt? H. H. F.

[69.] Does the heating effect vary regularly with the diameter of the wire before and after fusion? H. H. F.

Answers to Correspondents.

Readers are invited to send discussions regarding or answers to the queries published in the column above, or with regard to any other live questions on electrical subjects. In answering questions please refer to them by their serial number. Correspondence must be accompanied by the real name and address, not necessarily for publication, but as a guarantee of good faith. All correspondence should be as brief as is consistent with clearness. THE ELECTRICAL WORLD *assumes no responsibility for the opinions expressed by correspondents.*

[5.] In a recent paper by Mr. Stanley he states that light, heat, electric or magnetic impulse, travels 186,000 miles per second through the ether in vacuo. C. H.

[28.] As a result of many experiments I have found that the resistance of the human body varies from 1,050 to 3,200 ohms, and that it also varies from day to day under precisely the same conditions. C. L.

[27.] If the currents in the two circuits are continuous the effects would be practically the same in both cases. With alternating currents, even with the voltage of the two circuits exactly the same, the effect would depend upon the frequency of alternations, currents of low frequency being much more dangerous than those of high frequency. It is said that Mr. Tesla recently received without harm the full strength of 70,000 volts at the high frequency of 300,000 to 400,000. P. E. C.

[16.] It is essential that the weight, resistance and specific heat of the steel should be known. But for a first approximation the specific heat of iron may be used. Taking 65 degrees F. as a fair average temperature of the wire before applying the current, and 4.6 ohms as the resistance of four feet of the wire cold, the required number of ampères would be

$$A = 10\sqrt{0.1148 \times \text{weight 4 feet in grammes.}}$$

C. A. S. H.

News of the Week.

THE TELEGRAPH.

The Morse Patent Again.—In a recently published letter by Mr. Stephen Vail, son of the late Alfred Vail, brought forth by the protest of Mr. Morse's daughter to the Senate Library Committee, Mr. Vail defends his father's claims to the original patent. Referring to Chief Justice Taney's decision he said it was evident that it did not apply to the case of one who, like his father, took from Morse the crude wooden apparatus and, being unable to make it a practical success, threw it aside and invented an alphabet and mechanism himself, the so-called "Morse Alphabet," and the so-called "Morse Recording Receiver." This instrument is the one referred to in the bill before the Library Committee, and Mr. Vail states that he has in his possession an autographic statement of his father's concerning the inven tions in which he (Alfred Vail) says that he invented the lever and roller always used in the Morse instrument in 1844, before the line between Washington and Baltimore had been put up, but that he had not taken out a patent for it on account of his contract with Prof. Morse.

THE TELEPHONE.

Erie Telephone.—Sub-companies' increase of net earnings for January and February, over the same months last year, was $7,700. The net gain of subscribers, 109; total number connected March 1, were 14,120.

The Telephone Bill.—The committee on gas, electricity and water reported adversely to the Assembly Mr. Malone's New York and Brooklyn City Telephone Commission Bill. The adverse report was agreed to by a vote of 76 to 40. A motion to reconsider was lost, which effectually kills the bill.

Long Distance Telephone Line.—It is stated that a long-distance telephone circuit is contemplated between Portland, Me., and Cincinnati, the line running from Akron through Millersburg, Mt. Vernon, Columbus, etc. Maps have been drawn and specifications made out, and it is thought the line will be built this summer.

THE ELECTRIC RAILWAY.

Kinderhook, N. Y.—Chas. D. Haines has been at Fond du Lac, Wis., completing arrangements for the construction of an electric street railway plant, and expects to raise about one-fifth of the capital there.

Pittsburgh, Pa.—General Manager Burns, of the West End Street Railway, states that the road will be converted into an electric road at once, and that extensions will be built to Shalerville and Chartiers.

To Adopt the Trolley System.—At a meeting of the City Council of Merchantville, N. J., recently, an ordinance was passed giving permission to the Camden Horse Railroad Company to lay tracks through that borough, and also to erect trolley wires.

Johnstown, N. Y.—The board of trustees has granted a franchise to the Cayadutta Electric Railway Company, which will build a road from Fonda, N. Y., to Gloversville through Johnstown. It will be 12 miles long, and is to be completed by October 1.

The Hamilton (Ont.) Street Railway will be equipped with electricity. The contract, consisting of 30 cars and three multipolar generators with a capacity of 750 h. p., has been awarded to Ahearn & Soper, of Ottawa, Canadian representatives of the "Westinghouse system."

Plainfield, N. J.—The City Council has granted to the Plainfield Street Railway Company, a syndicate of Essex county capitalists, a franchise to construct and operate a street railway on the overhead trolley system through certain streets of the city. The road is to be completed within six months.

The Union Railway Company, of Chester, Pa., has been granted by the City Council of Media, Pa., right of way through Media for the proposed electric railway to connect Media and Chester. The road will be five miles long and will pass through East Media, Moyland, South Media, Wallingford and Shoemakerville.

Electric Railway for Sing Sing.—Sing Sing, N. Y., is to have an electric railroad through its principal streets. The trolley system will be used and the fare will be five cents anywhere about town. The main line will run from the railroad station to the Sing Sing camp meeting grounds. Another branch will run down Spring street to the boundary line.

Electric Railway to Long Branch.—The project of building an electric railroad between Red Bank, N. J., and Long Branch has been revived, and it is stated that the road will be constructed. Several New York capitalists are at the head of the movement, and a number of local parties are interested. Already $8,500 has been called for, to be paid in on or before May 1. The name of the company is the Seashore Electric Railroad Company.

Electric Roads in Troy.—There is considerable activity in railroad circles in Troy. The work of equipping the Troy City Railroad for the operation of electric cars has begun, and will be pushed rapidly to completion. The Albia end of the line will be first completed, and as soon as the repaving of the streets will permit the entire line will be equipped. The plans for the new power station have been completed, and the plant will occupy a site on River street, south of Ferry street. Work on the Broadway and Third street loop of the Troy & Lansingburgh Railroad will be begun this week. The completion of the Fourth street line will follow, and the equipment of the extended lines with electric cars will be completed, it is thought, early this summer.

The Trolley in Philadelphia.—The Traction Company does not expect to commence the work of construction for about six months. It is estimated that the plant will cost between $4,000,000 and $5,000,000, and require about two years for completion, and probably give employment for 5,000 men. The system to be used has not yet been decided upon. The Traction company states that it will do nothing without the approval of the city, and suggests that the mayor and some of the city officers accompany the officers of the company on a tour of inspection, visiting Boston, Rochester, Cleveland and other cities, in order that they may jointly decide which is the best system. In a meeting of the joint Committees on Laws and Railroads a motion to report the repealing ordinances to the Councils with a negative recommendation was agreed upon by a vote of 25 to 15. By the same vote the resolution asking the Mayor to withhold permits was directed to be reported negatively.

The New Jersey bill to legalize the trolley lines of the Newark Passenger Railway Company, which was passed in the last session of the Legislature, Governor Abbett has refused to sign, and all the trolley lines in the State are placed in the position of operating in contravention of law. By Supreme Court decision it was declared that the Council of Newark had no authority to grant franchises for electric trolley lines, and that its power was limited to the regulation of travel by horse or steam power. In consequence of this decision it was thought best to seek to have the Legislature pass an enabling act, which was done. What to do now is the problem which confronts the street railway people. Unless delay can be gained poles will have to come down, and costly electric plants will be rendered worthless. An appeal may be made to the Court of Errors in the hope that by the time a decision is reached the next Legislature may be in session and grant relief.

THE ELECTRIC LIGHT.

Claremont, N. H., is to have a system of electric lighting.

Kinderhook, N. Y., is soon to have an electric light plant.

Bridgewater, Mass., has voted $2,400 for electric lighting.

Sprague, Wash., recently voted for the purchase of an electric light plant.

Green Island, N. Y.—The town clerk will receive bids for a system of arc lighting.

Atlantic Highlands, N. J., contemplates putting in a system of electric lighting.

West Milton, O., has been authorized to issue bonds to pay for an electric lighting plant.

Yreka, Cal.—The Yreka Electric Light Company is considering the installation of a power plant.

Dunsmuir, Cal., is to be lighted by electricity. Power will be obtained from the Sacramento River.

Mount Gilead, O.—The town has been authorized to issue bonds to pay for an electric lighting plant.

Keosauqua, Ia.—At a recent election the proposition to have electric lights was carried by a vote of 135 to 10.

San Angelo, Tex.—The San Angelo Light, Power and Irrigating Company will put in additional dynamos.

Arlington, Ore.—The citizens of Arlington have voted to bond the town for $10,000 for the purpose of establishing electric light and water works.

Berwick, Pa.—Citizens of this place are dissatified with the present system of lighting and there is strong talk of an electric light system.

Weedsport, N. Y.—Sealed proposals will be received by David Servis, village clerk, to April 20 for lighting the streets of the village by the electric system.

Scranton, Pa.—Scranton Electric Light and Heat Company has been authorized to light the city with arc electric lights for one year at 25 cents a light per night.

Morrison, Colo.—A company of Denver capitalists is figuring upon putting up an electric light and power plant in this place. The Board of Trade will consider the matter.

Port Richmond, S. I.—Trustees have under consideration a proposition to buy out the plant of the Staten Island Water Company and construct their own electric lighting system.

Milton, Mass.—It is stated that a stock company has been formed here to purchase the electric lighting plant and business, and that they will enlarge and improve the works.

Holbrook, Mass.—Holbrook is to have electricity for house and street lighting. Albion Allen, of Brockton, has canvassed the town and a company has been formed to erect a plant in the town.

Bath, N. Y.—The Village Board has signed a contract with the Hyer and Sheehan Electric Lighting Company for 48 lights to be lighted 240 nights during the year, at a cost of $68 per light per year.

Withdrawal of Franchise.—The Board of Aldermen of Long Island City has rescinded the resolution of the former board, it is stated, which granted a franchise to the Electric Illuminating Company.

To Have the Electric Light.—The following towns and cities are moving in the matter of electric lighting: Globeville, Col.; Greenville, Ill.; Caldwell, Idaho; Henry, Ill.; Kendrick, Wash., and Maysville, Mo.

Millersburg, Pa.—I. Koppenhaver has sold out his interest in the Millersburg Electric Light Company to J. P. Buck, and the latter states that operations will soon be commenced to get the plant in working order.

Circleville, O.—The Circleville Electric Light and Power Company has purchased the stock of the old company, capital stock $100,000. The new company will rewire the town. George G. Hamilton, of Mt. Stirling, Ky., and H. Worthington, of Cincinnati, O., are interested.

Malden, Mass.—A new electric light plant is to be built by the Malden Electric Company. It will cost about $50,000, and the company will have two plants which will be separated by a fire proof partition. When completed the company will furnish a day power and lighting service.

Mifflintown, Pa.—An electric light company has been organized. John J. Patterson is president, B. F. Burchfield is secretary, and Ezra C. Doty is treasurer. Directors: J. Jeff Middaugh, John J. Patterson, Jr.; Harry E. Bensall, W. S. North, Wm. Allison and Alfred J. Patterson. Work will be begun at once.

An Electric Light Company to be Sold Out.—The movable property of the Millville Schuyler Electric Light Company, of Millville, N. J., was announced to be sold by the sheriff on April 14. The company suspended operations a few weeks ago, as a result of losing the contract for lighting the city. The property has been attached, it is stated, on complaint of W. H. Corbin, of New York, the principal creditor.

The Deer Lodge Electric Company, of Deer Lodge, Mont., has contracted with the Electrical Engineering and Supply Company, of St. Paul, to install a complete central station plant of 30 arc light and 750 incandescent light capacity. The National transformer system of incandescent lighting will be used and the Sperry arc light machine. The steam plant includes a 125 h. p. Ideal engine. This plant is to be completed on or before the first of June.

In Favor of Municipal Lighting.—At an adjourned town meeting in Melrose, Mass., March 21, it was voted for the second time to accept the municipal lighting act, by a vote of 157 to 25. The report of the committee on electric lighting was accepted. A motion to issue 75 $1,000 electric light bonds to run for 30 years, and to bear interest at four per cent., semi-annually, was defeated by a vote of 152 to 82, a two-thirds vote being necessary. It was voted to reconsider the matter at an adjournment of the town meeting, on a motion for reconsidering the vote.

LEGAL NOTE.

Decision of the Accumulator Company's Suit.—Judge Coxe, in the United States Circuit Court, has filed a decision in the suit brought by the Accumulator Company against the New York & Harlem Railroad Company to restrain it from using the Swan perforated storage battery cells on the Fourth avenue line, in favor of the Accumulator Company. The New York & Harlem Railroad Company was defended by the Consolidated Electric Storage Company, the successor of the Julien company and the licensees of the Brush Electric Light Company's patents. It is claimed that this decision gives the Accumulator company the exclusive right to the Swan cell.

Legal Status of Electricity.—The Supreme Court of Alabama has handed down the following decision in the case of the Consolidated Electric Light and Gas Company: Electricity has been long enough employed and its uses and dangers sufficiently ascertained to authorize the statement of certain propositions as falling within the purview of common knowledge. Among them are the following: (1) Contact with electrical conductors sufficiently charged to subserve the purposes of illuminating destroys animal life. (2) To properly regulate the apparatus for distributing electrical light requires that the employés or servants shall ascend the poles and go among the wires. (3) Two sets of wires, occupying the same space, and charged from different dynamos, located apart, and controlled by separate and independent engineers, could not fail to be dangerous in many ways. The following authorities apply to the question: Thomp. Electr. sections 43, 92, 93; Teachout v. Railroad Co. (Iowa), 28 N. W. Rep., 145; Gas Light Co. v. Hart (La.), 4 South. Rep., 215; Nebraska Tel. Co. v. York Gas & Electric Light Co. (Neb.), 43 N. W. Rep. Where one company secures an injunction restraining another from placing its wires in close proximity to those operated by it, and the answer only shows that danger would not ensue "with reasonably prudent management of complainants' wires," does not warrant a dissolution of the injunction.

PERSONALS.

Mr. Nelson Bennett has been re-elected president of the Fairhaven (Washington) Electric Light and Power Company.

Andrew B. Uline, general manager of the Hudson River Telephone Company, died on April 4, at Nassau, N. P. Mr. Uline was born in West Sand Lake, Rensselaer county, N. Y., July 17, 1836. In 1863 he went to Albany as agent of the Merchants' Dispatch, and in 1878 he formed the Commercial Telephone Company, which was subsequently merged into the Hudson River Telephone Company.

Mr. Edward H. Chapin, well known as having been connected for some time with the *Street Railway Journal* of this city, is to be married on Thursday evening, April 28, at Genesee, N. Y., to Miss Louise Beach, daughter of Mr. and Mrs. Charles A. Beach. Mr. and Mrs. Chapin will be at home Thursdays, June 2d and 9th, at 88 South Fitzhugh street, Rochester, N. Y. The many friends of Mr. Chapin will wish himself and bride a long and happy married life.

Marmont B. Edson died in New York on the evening of April 3. Mr. Edson was born in 1813 in Otsego county, N. Y., but came to New York City early in life. After his marriage he went West, but in 1860 returned and settled in Brooklyn. Mr. Edson was of an inventive turn of mind, and was interested in the Gold and Stock Telegraph Company, the Bell Telephone Company, and other similar enterprises. He was the father of Jarvis B. Edson, the inventor of the Edson Steam Pressure Gauge.

Industrial and Trade Notes.

The Detroit Electrical Works on and after April 15 will remove its Chicago office from 431 The Rookery to suite 917 and 918 Monadnock Building.

The Partrick & Carter Electrical Supply Company, of Philadelphia, has discontinued its Canadian agency and hereafter will supply the trade direct. Catalogues and special trade discount sheets will be sent on application.

Anti-Rust Paint.—The Canton Steel Roofing Company, of Canton, O., is supplying the trade with paint that is guaranteed to preserve iron or steel surfaces from the effects of exposure to the weather, or to dampness in any form.

The Edison General Electric Company has established a branch of its fixture and decorative bronze department in connection with its wareroom at 41 Niagara street, Buffalo, N. Y., which is in charge of H. B. Oakman, resident agent.

The Fitch Battery and Electric Company, of Oneida, N. Y., in a recent communication to the trade, states that all carbon cylinders, which it furnishes, are manufactured under authority of the Holtzer patent, and that in using these batteries no liability for infringement is incurred.

The Electric Appliance Company has just received its first shipment of Cutter specialties and has them on exhibition at its store, where they are attracting considerable attention. Its flexible brackets, and portable as well as C. S. shades, are certainly very desirable specialties.

The National Electric Manufacturing Company, of Eau Clare, Wis., has recently sold a 100-h. p. multipolar generator with complement of motors to the Columbus (O.) Buggy Company, and two 50,000 watt depositing machines to the Midland Chemical Company, Midland, Mich.

Manion & Company, of New Orleans, La., have recently started an electrical supply house and construction department in connection with their other branches of business, and will enter the field for electrical business. They are already doing an extensive plumbing, steam and gas fitting business.

The Central Electric Company, of Chicago, is sending out a handsome circular in reference to tested fuse wire and terminal fuses. The circular contains an article on fuse wire that was read before the Chicago Electric Club December 7, 1891, by Mr. Elmer A. Sperry, and contains valuable information on this most important subject.

Ways and Means is the title of a little book of 158 pages which has just been published by John W. Weston, Chicago. It is designed for machinists, metal workers, model makers, watch and tool makers, jewelers, draughtsmen, etc., and contains a collection of hints and helps for artisans. It is written by A. H. Cleaves, M. E., and contains 125 illustrations. Price $1.

Good Words Unsolicited.—The Shultz Belting Company recently received the following communication from the Halifax Illuminating and Motor Company, Limited, of Halifax, N. S: "Please send us, per express, one endless covering for 18-inch diam., 13-inch face pulley. Also send us one pint tin of your belt cement, as we have had nothing to equal it. If is was not for your covering on pulley we would not be able to run without increasing our length of belt, and that we can't do. Belt has slipped on 6-ft. driver, and stuck well without slipping on small pulley with your covering."

Pepper & Register, electrical and mechanical engineers, Provident Building, Chestnut and Fourth streets, Philadelphia, have secured the order to build and equip the Delaware Bay & Cape May Electric Railway, a 6½ mile road, with 10 car equipments; generator to be 150 h. p., and cars to be equipped with 30 h. p. single reduction motors, both of the Westinghouse Electric Company's manufacture. Ball engines are to be used, Coatesville boiler and stack, Schieren's belts, Morris-Tasker company's brackets for pole construction, and Washburn & Moen's trolley wire. The road is to be in operation, complete, by the first day of June. Pepper & Register have also secured an order to build, complete, the municipal electric lighting plant for Doylestown, Pa., and several isolated plants, work upon which will begin at once.

Christopher Columbus Chart.—Without a doubt the only concise, correct and comprehensive chart of the kind ever issued or distributed since 1492, is the one which the Mason Regulator Company of Boston has got up and is sending out accompanied by the following circular announcement: "Columbus discovered America, and did a very good thing. This chart may discover to you the Mason Regulator Company. Having discovered it, hang the chart up where it will be a constant reminder to you that in the manufacture of steam regulating devices, we, like Columbus, are seeking new fields for usefulness. We make these standard goods: reducing valves, pump pressure regulators, pump governors, air brake regulators, damper regulators, balanced and lever valves, piston throw indicators. Mason Regulator Company, 10 Central street, Boston."

Warren Webster & Co. report orders booked during the last few weeks as follows: Through their European company, headquarters at Antwerp, Belgium, three orders for Webster's Vacuum

Heater and Purifier; U. S. A.—one 1,200-h. p., being second order from National Tube Works Company, McKeesport, Pa.: one 1,500-h. p. from Republic Iron Works, Pittsburgh, Pa.; one 1,500-h. p., third order from Anhauser-Busch Brewing Association, St. Louis, Mo.; one 1,600-h. p., fifth order from Cleveland Rolling Mill Company, Cleveland, O.; one 200-h. p. from Pennsylvania Steel Company, Harrisburg, Pa. Their factory is working to its full capacity, and the prospects of business are excellent for a very successful year. They furnish their vacuum feed water heaters and purifiers upon trial, and also report that they have experienced an excellent business during the past winter with the Williames vacuum system of steam heating. They furnish catalogues free, and visit plants at their own expense in any part of the United States where estimates are desired.

The Harrisburg Foundry and Machine Works, of Harrisburg, Pa., reports the following orders received during the past ten days: Two 10 and 17 × 14 Tandem compound engines for St. Paul; one 13 × 12 plain Ideal engine for St. Paul; three 125-h. p. Ideal engines, with corresponding steel return tubular boilers, also pump, heater, piping, etc., for Wilkesbarre and Wyoming Valley Traction Company; two 18½ × 18 plain Ideal engines for New York City; one 13 × 18 standard Ideal engine for Boston; one 125 h. p. Ideal engine, steel return tubular boiler, heater, piping, etc., for Georgetown & Tenallytown Electric Railway, Washington; two steel return tubular boilers for the Allentown Electric Light Company; one 60-h. p. standard Ideal engine and steel return tubular boiler for manufacturing purposes, Newville, Pa.; one 25-h. p. Ideal engine for U. S. Naval Observatory, Washington, D. C.; one 50-h. p. engine and steel return tubular boiler for manufacturing purposes, at Newport, Pa. Besides these they have a number of small Ideal engines for New York City; also tanks, filters, accumulators, etc., for ice work and other sheet iron users. Besides these orders the company has about an equal amount for the month previous and is running to its fullest capacity and is increasing its facilities as rapidly as possible.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

The Mather Electric Motors combine the highest efficiency and workmanship consistent with a reasonable first cost. Perfect automatic regulation of speed from no load to full load. For catalogue and information address E. T. Pardee, agent, 14 Butler Block, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED APRIL 5, 1892.

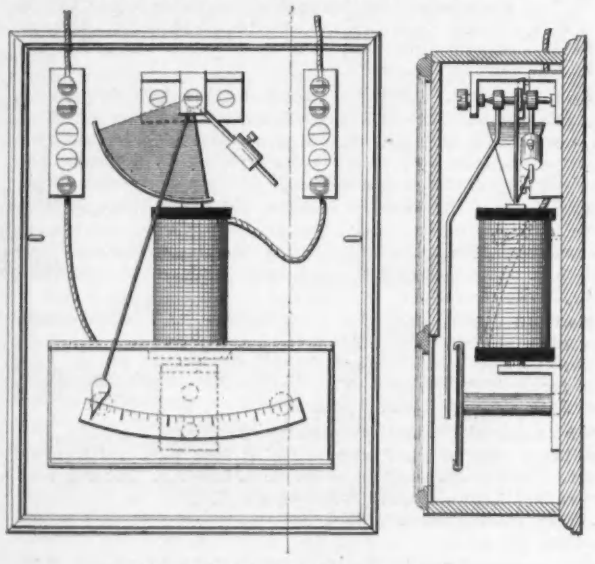
472,026. Galvanometer; Sigmund Bergmann and George A. Scott, of New York, Assignors by mesne assignments to the Interior Conduit and Insulation Company, of same place. Application filed Feb. 25, 1891. In an electrical meter the combination of a magnet, a metal strip longitudinally curved and gradually widened from one end to the other and supported adjacent to the pole of said magnet and a weight or its equivalent for moving the strip in the reverse direction to that in which it would be moved by the magnet. (See illustration.)

472,027. Switch and Switch Box; Sigmund Bergmann, of New York, Assignor by mesne assignments to the Interior Conduit and Insulation Company, of same place. Application filed March 13, 1891. In a conduit system the combination of a cylinder or receptacle for a switch, a base piece removably fitted in said cylinder or receptacle, a switch made complete in one structure secured to the base piece and removable therewith from the cylinder or receptacle, a cap piece for holding said switch and base in place and a spring surrounding a rotary part of the switch and serving to press said cap piece outward and bearing inward on said switch.

472,037. Thermo-Electric Element; Edward N. Dickerson, of New York, Assignor to the Thermo-Electric Company, of West Virginia. Application filed Feb. 27, 1890. In a thermo-electric element a series of parallel plates of different metals held firmly in contact with each other and adapted to be heated at one end.

472,055. Carbon Holder; Henry Howard, of Haletown, near Birmingham, England. Application filed Oct. 21, 1891. In a carbon holder the combination of a support for the carbon, a screen of colored glass carried by the support and an opaque bar interposed between the carbon and the screen.

472,062. Theostat; James R. Masury, of Providence, R. I., Assignor of one-half to Lawrence J. McCarty, of Boston, Mass. Application filed June 29, 1891. A current regulator composed of a reservoir of conducting liquid combined with an electrode supported therein, having a tapering recessed surface and a co-operating movable electrode having a tapering exterior surface slightly smaller at the base than the recessed surface of the first-mentioned electrode, whereby said electrodes make contact only at the apexes of said surfaces and when in contact have a thin film of conducting liquid of large extent between them.



No. 472,026.—GALVANOMETER.

472,064. Electric Arc Lamp; John A. Mosher, of Chicago, Ill., Assignor to the Mosher Arc Lamp Company, of Abilene, Kan. Application filed June 20, 1891. In an electric arc lamp, the combination, with the guide tube and the carbon holder arranged to move in the tube, of a movable frame carrying feed mechanism and a chain or cord attached to and supporting the holder and the other end attached to the movable frame and passed over a pulley on the tube.

472,084. Safety Cut-Out; Mandeville Thum, of Louisville, Ky. Application filed June 5, 1891. In a safety device for electric circuits, the combination, with the main circuit, of a branch circuit, an electro-mechanical device therein, electric contacts in the main circuit adapted to be operated by said electro-mechanical device, contacts in the branch circuit, and an electro-mechanical device in the main circuit and adapted to control the latter contacts.

472,135. Lightning Arrester; Edward G. Miller, of Wilkinsburg, Pa. Application filed Aug. 27, 1890. The invention consists in a helix provided with a mercury switch at the bottom, and furnished with a movable core or armature for displacing the mercury.

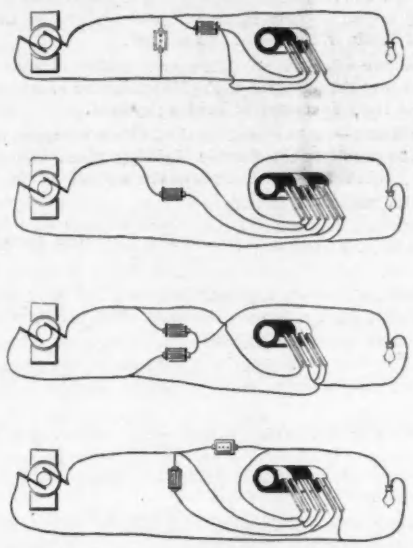
472,169. Toll-Collecting Apparatus for Telephones; Jesse J. Kato and Thomas H. Rhodes, of Los Angeles, Cal. Application filed March 28, 1890. In combination with a telephone, a toll-collecting apparatus comprising a coin receiver, a normally closed local circuit, means for breaking said circuit by the deposit of a coin, a second normally closed local electric circuit, clock mechanism, and connections for breaking said second circuit by winding the clock, and means whereby said clock mechanism is adapted to simultaneously close both of said circuits at a predetermined point in its movement.

472,193. System of Electrical Distribution; William Marshall, of New York. Application filed Feb. 28, 1891. In a system of electrical distribution, a direct current generator and a translating device in the circuit of the said generator, a condenser in a branch of the said circuit, and an automatic circuit changing device having connections both to the branch or condenser circuit and to the main circuit containing the translating device, the said connections being such that the circuit is alternately set for charging the condenser and for discharging the same through the said translating device. (See illustration.)

472,220. Hanger for Electric Wires; Henry Herbert Luscomb, of Boston, Mass. Application filed July 20, 1891. A support or hanger having a head, a stem to one end of which the head is pivoted and an arm serving as a stop for the head and also to transmit a part of the strain on the head when in use to adjacent parts of the stem.

472,237. Unison Apparatus for Printing Telegraphs; Henry Van Hoevenbergh, of New York, N. Y. Application filed July 20, 1891. In a printing telegraph, the combination with a main line circuit of a step-by-step transmitter organized to drop or intermit one of a series of breaks or impulses and a receiving instrument organized to supply the break or impulse omitted by the transmitter.

472,243. Telephone Transmitter; Edward G. Acheson, of Pittsburgh, Pa. Application filed June 29, 1887. In a telephone the combination of a plate, blocks of conducting material secured on each side of said plate, bars of conducting material resting thereon, rings of rubber surrounding each bar and a thread or cord connected to said rings and securing said bars in position upon the blocks.



No. 472,193.—SYSTEM OF ELECTRICAL DISTRIBUTION.

472,261. Thermo-Electric Battery; Robert Jacob Gülcher, of Berlin, Germany. Application filed June 16, 1891. In a thermo-electric battery, the combination, with a source of heat, of elements having different internal resistances, said elements being arranged in a graduated series, the elements of less internal resistance being arranged at a distance from the source of heat so that the resistance of each element is substantially proportional to the temperature to which it is subjected and all the said elements of different internal resistances being connected in series.

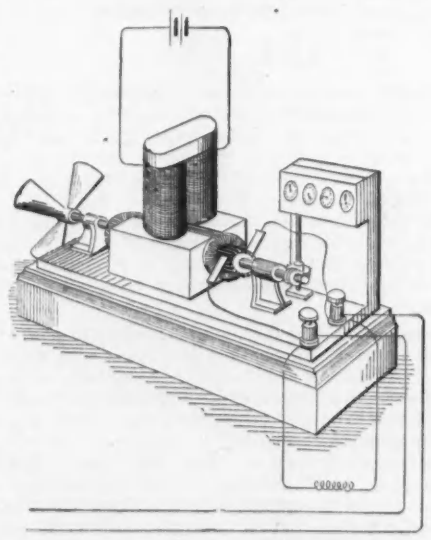
472,265. Electrical Meter; John F. Kelly, New York. Application filed Aug. 18, 1891. A coulomb meter, consisting in the combination, with a motor having a constant field, of a shunt or path of low resistance around the terminals of the motor, whereby the difference of potential at the terminals will be determined by the shunt, a load consisting of such a device as a fan and means for indicating or registering the revolutions of the shaft. (See illustration.)

472,274. Electric Arc Lamp; Samuel W. Rushmore, of Brooklyn, N. Y. Application filed July 27, 1891. The combination, in an arc lamp, of a movable carbon or carbon-carrying rod, a shunt coil, a clutch ring or plate controlled thereby, a series coil, and a separate feeding device controlled thereby, one of said devices acting as a check on the other. (See illustration.)

472,283. Switch Box for Electric Motors; Parvin Wright, of Denver, Colo., Assignor of one-half to Joseph W. Kinsey, of same place. Application filed Jan. 31, 1891. An electric motor having its field magnets located directly in circuit with a source of electrical energy and its armature in a derived circuit thereto, in combination with a pole changing switch for reversing the direction of the current through the armature, and a second normally open independent circuit operatively connected, whereby the first named circuit may be broken and the second closed, and vice versa.

472,329. Electric Wheel-Locking Device; George W. Blanchard, of Waterville, Me. Application filed Aug. 10, 1891. In combination with a rotating wheel, a disc turning therewith, dogs or looking devices engaging the disc, and electrically actuated means for drawing them into such engagement.

472,339. Annunciator; William C. Dillman, of Brooklyn, N. Y., Assignor to Owen Walsh, of New York. Application filed Dec. 22, 1891. The combination, with a speaking tube, of a contact supported above the tube and forming one terminal of an electric bell circuit, a swinging contact forming the other terminal of the bell circuit and arranged beneath the upper contact and adapted to strike the same, and a fan connected with the swinging contact and extending into the bore of the tube.



No. 472,265.—ELECTRICAL METER.

472,346. System of Arc Lighting; Horatio A. Foster, of New York. Application filed Jan. 29, 1891. In an arc lamp, the metallic lamp mechanism box insulated from the current carrying parts of the lamp and provided with a flange for the upper edge of the lamp globe, the yoke, the negative carbon holder insulated from the lamp box walls, a globe enclosed the yoke and holder, and a globe support secured to the yoke by suitable means and lamp terminals suitably insulated and enclosed in metallic casings.

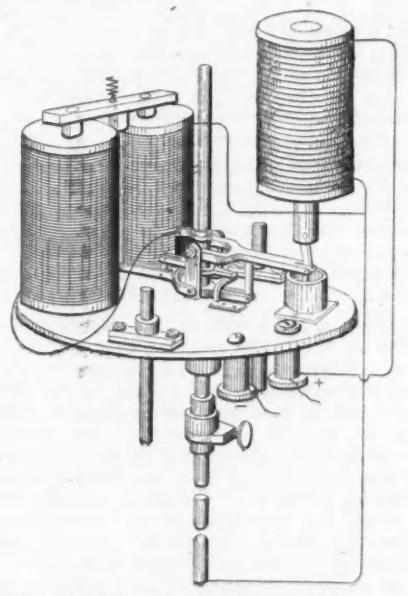
472,352. Compound for Insulating Electric Wires; Louis Hill, of Waterbury, Conn. Application filed July 11, 1891. A compound for insulating wire, consisting of pittzite pitch, candle-tar, coal-tar, asphalt pitch and rosin.

472,359. Electric Indicators for Railroad Blocks; Ribert W. Jaggard, of Philadelphia, Pa. Application filed April 6, 1891. In a system of electrical indicators for railroad blocks, the combination of signals, neutral and polarized magnets having armatures for actuating the signals, the armatures of the neutral magnets controlling the armatures of the polar magnets, and the electrical connections.

472,379. Production and Distribution of Electricity; William Marshall, of New York. Application filed Nov. 23, 1889. The method of distributing electrical energy from an electric source, which consists in alternately charging an electrical condenser from the said source, and throwing into the line beyond the condenser the currents of both the condenser and the electric source, these acts being performed with such rapidity as to make the effects in the line appear continuous.

472,435. Brush Holder; John R. Coffman, of Detroit, Mich., Assignor of one-half to C. A. Benton, of same place. Application filed Sept. 30, 1891. The combination, with the commutator brush fixed movably in a slideway to be pressed against the commutator and the spring pressing the brush therein, of a holder for said spring, also fixed movably in a slideway toward the commutator, and means to adjust said holder and maintain substantial uniformity of pressure of the brush on the commutator by the spring.

472,440. Annunciator; William C. Dillman, of Brooklyn, Assignor to Owen Walsh, of New York. Application filed Dec. 22, 1891. The combination with the perforated tube and the air chute mounted within the tube and terminating beneath the perforation of a swinging contact mounted above the perforation and forming one terminal of a circuit which includes a bell and a fixed contact forming the other terminal and arranged in the path of the swinging contact.



No. 472,274.—ELECTRIC ARC LAMP.

472,447. Inclosed Supply System for Electric Railways; John C. Fyfe, of Denver, Colo. Application filed Dec. 26, 1890. In combination with the main conductor, the feeder-wires extending therefrom at intervals along the line of said conductor, normally open local circuit connections correspondingly arranged along the line of said conductor, adapted when closed to take current through mercury in contact with said feeder-wires, and mechanism actuated by a moving car for making contact with said feeder-wires, and mechanism actuated by a moving car for making contact between said circuit connections and the mercury in contact with said feeder-wires, so as to automatically close the local circuits.

472,461. Electro-Magnetic Valve-Controller; Olof E. Lundstedt, of Brooklyn, N. Y., Assignor by mesne assignments to the New York Electrical Device Company, of Virginia. Application filed Aug. 6, 1890. The combination, with the spindle of a rotating valve and an arm extending radially therefrom, of a pivoted bent lever having arms of unequal lengths, and armature upon the shorter end of said lever, an electromagnet attracting said armature, a spring retracting it, a single lever pivoted at one end at a point beyond the long arm of the bent lever to extend thence toward the pivotal axis thereof, a link coupling the long arm of the bent lever with the single lever near to its pivotal axis, and a link connecting the outer end of said single lever with the radial arm of the valve spindle.

472,480. Adjustable Armature for Electromagnets; Emil Hofmann, of Ballard Vale, Mass., Assignor to the Craighead & Kintz Co., of same place. Application filed Sept. 22, 1891. The combination, with an electromagnet, of an armature-carrier having recessed side arms, an armature, guide pins thereon to enter said recessed side arms, and a screw having an annular groove connecting said armature and carrier, and a screw or pin entering said groove.

472,500. Electrical Indicator; John W. Henderson, of Philadelphia, Pa., Assignor to the Wharton Railroad Switch Company, of same place. Application filed Nov. 13, 1885. A detector or indicator for indicating the two extremes or the intermediate position of a moving object, consisting of two electric circuits, each provided with an electromagnet adapted to attract the armature of a needle or pointer, and also an electromagnet to attract an armature, the circuit having an alarm located therein and made continuous when both of the armatures are drawn away from their electromagnets, and a moving object in circuit with the aforesaid mentioned electromagnets and adapted in its extreme positions to close the circuit through either of said sets of electromagnets and a battery to provide the current for either of said circuits.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.